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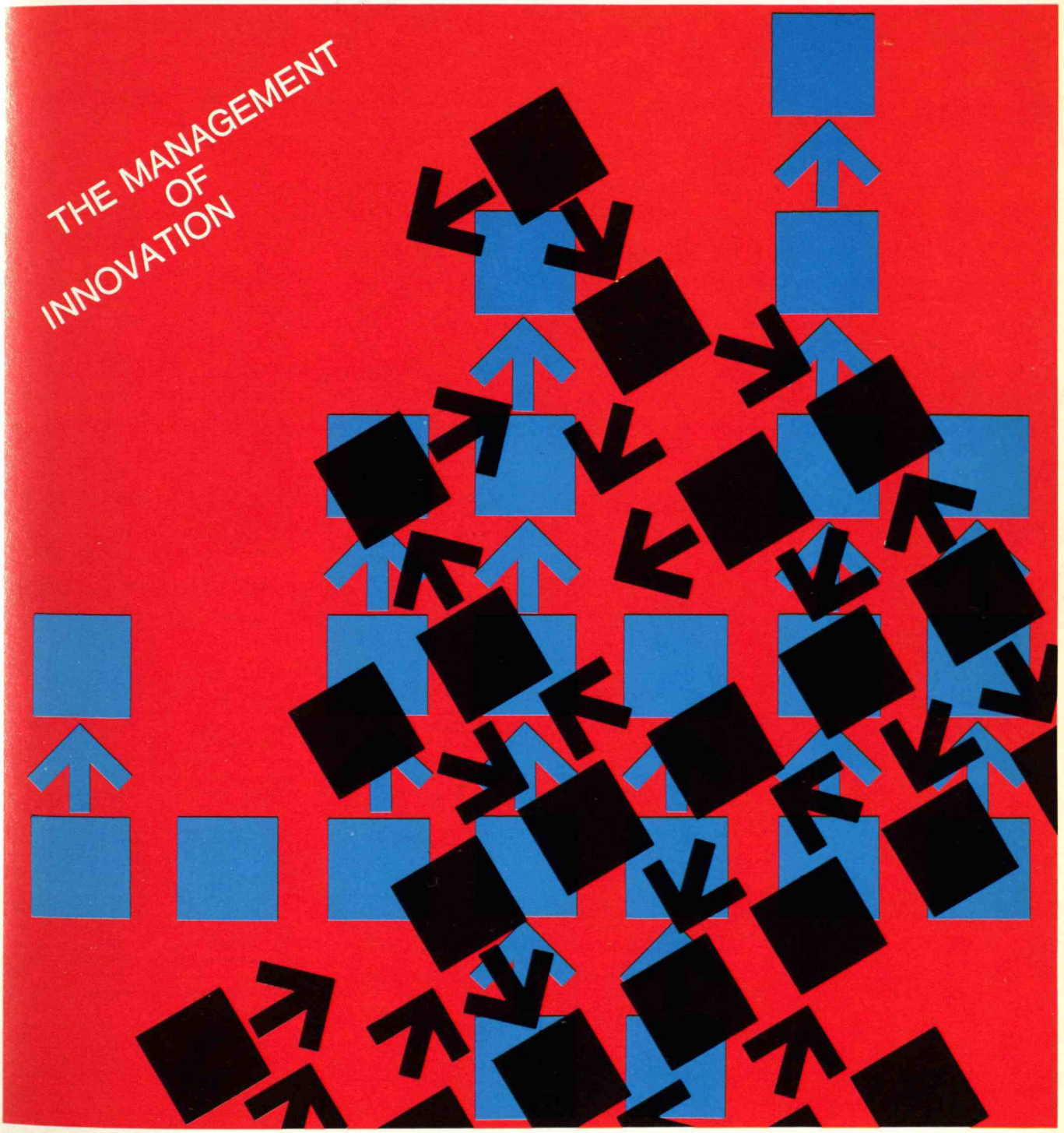

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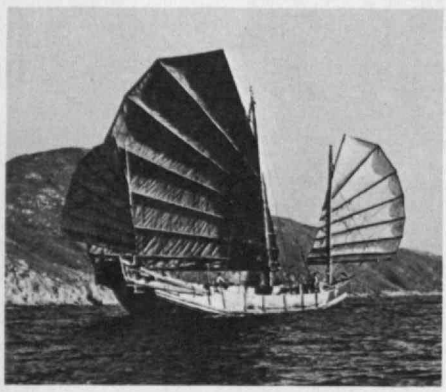

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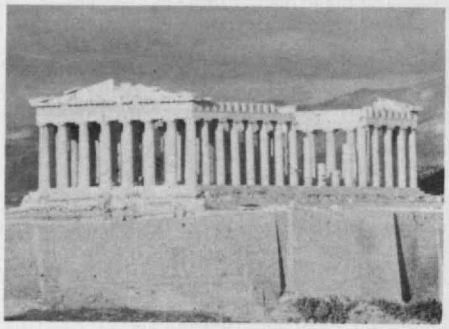

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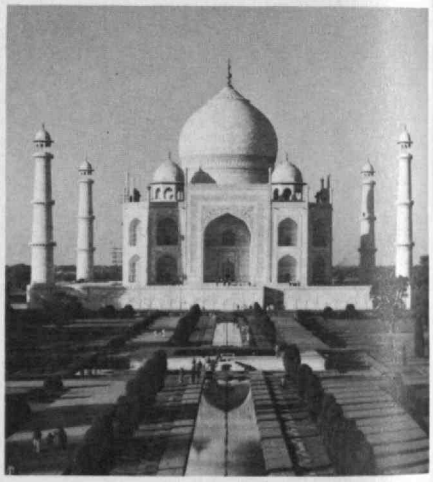

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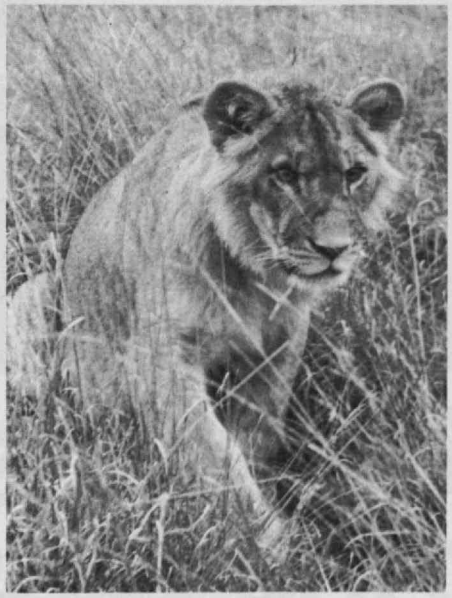
22 DAYS $1739

A luxury "safari" to the great national parks and game reserves of East Africa, offering a breathtaking combination of wildlife and scenery: game viewing in the wilderness of Kenya's Northern Frontier district at SAMBURU RESERVE; a night at world-famous TREETOPS in the ABERDARE NATIONAL PARK; the spectacular masses of pink flamingos at LAKE NAKURU; multitudes of lion, zebra, wildebeest and other plains game in the MASAI-MARA RESERVE and the famed SERENGETI PLAINS; the great permanent concentrations of wildlife in the NGORONGORO CRATER; tree-climbing lions along the shores of LAKE MANYARA in the Rift Valley; photographing rhino and other big game against the majestic snow-covered background of Mt. Kilimanjaro in the AMBOSELI RESERVE; and the vast and fascinating wilderness of TSAVO NATIONAL PARK, renowned for its elephant and lion and for the unusual desert phenomenon of the Mzima Springs. There is also a stay in NAIROBI, the most fascinating city in East Africa, as well as features such as a visit to a MASAI MANYATTA to see tribal dancing and the tribal way of life. The altitude in East Africa provides an unusually stimulating climate, with bright days and crisp evenings (frequently around a log fire), and the tour follows a realistic pace which ensures a full appreciation of the attractions visited. Total cost is $1739 from New York. Optional extensions are available to the VICTORIA FALLS, on the mighty Zambezi River between Zambia and Rhodesia, to UGANDA, and to the historic attractions of ETHIOPIA. Departures in January, February, March, May, June, July, August, September, October, November and December 1973 ($26 additional for departures in June, July and August).



NORTH AFRICAN ADVENTURE

Preliminary Announcement

A new tour to North Africa and the regions which surround it, visiting GIBRALTAR, MOROCCO and the CANARY ISLANDS. GIBRALTAR, the gateway to North Africa, is the first stop, followed by a crossing of the narrow Strait of Gibraltar to TANGIER, on Morocco's northern coast. From Tangier, the tour proceeds by road to the imperial cities of MEKNES and FES, with an excursion to the Roman ruins of VOLUBILIS, then crosses the Atlas Mountains to the pre-Sahara and ERFOUD, on the edge of the desert. From here, the famed "casbah trail" leads through TINERHIR and OUARZAZATE to MARRAKECH, where an extended stay is provided before continuing to CASABLANCA. The visit to the CANARY ISLANDS, lying off the coast of Africa, will include stops in TENERIFE, the volcanic island of LANZEROTE, and LAS PALMAS. It is anticipated that the tour will be of three weeks' duration and that it will be inaugurated in the fall of 1973. Further details, including the tour cost, will be announced as soon as possible.

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Preliminary Announcement

An unusual blend of countries in the Mediterranean area, visiting TUNISIA, the Dalmatian Coast of YUGOSLAVIA, and MALTA. Starting in TUNIS, the tour explores the coast and interior of Tunisia: the ruins of the famed ancient city of CARTHAGE as well as the ruins of extensive Roman cities such as DOUGGA, SBEITLA, THUBURBO MAJUS and the magnificent amphitheater of EL DJEM, historic Arab towns and cities such as NABEUL, HAMMAMET, SOUSSE and KAIROUAN, the caves of the troglodytes at MATMATA, beautiful beaches at ZARZIS and on the "Isle of the Lotus Eaters" at DJERBA, and desert oases at GABES, TOZEUR and NEFTA. The beautiful Dalmatian Coast of Yugoslavia is represented by SPLIT, with its famous Palace of Diocletian, and the medieval walled city of DUBROVNIK, followed by the island of MALTA, with its treasure house of 17th and 18th century churches and palaces, where the Knights of St. John, driven from the Holy Land and from Rhodes, withstood the epic seige of the Turks and helped to decide the fate of Europe. It is anticipated that the tour will be of three weeks' duration and that it will be inaugurated in the fall of 1973. Further details, including the tour cost, will be announced as soon as possible.

* * *

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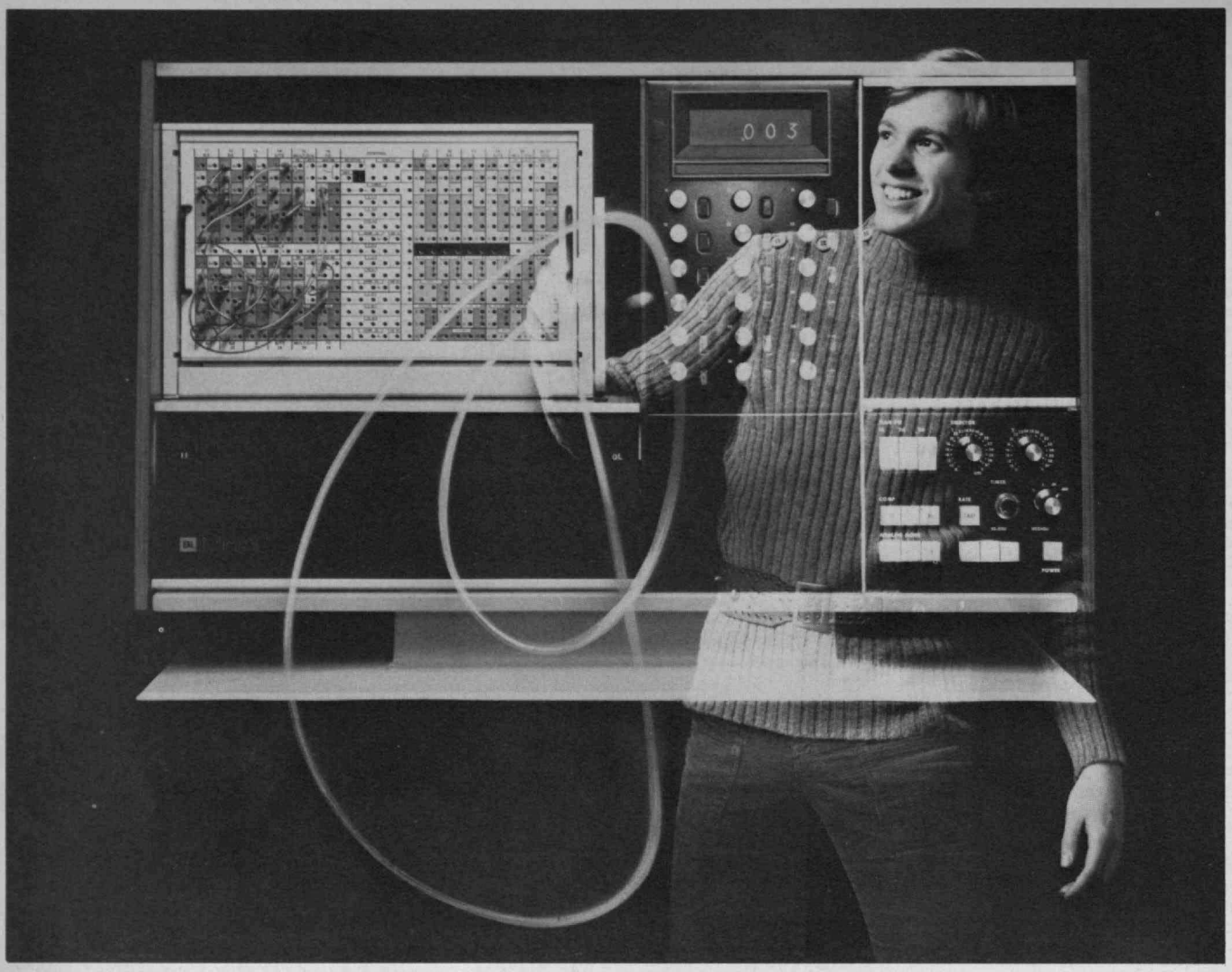

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Technology Review

Edited at the
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Volume 75, Number 5
March/April, 1973

Articles

Departments

First Line

The Fusfeld Controversy II and an Erratum

Last month in this space we commented on the (minor) controversy in our editorial offices about the acceptability for *Technology Review*'s audience of such simple mathematical expressions as those used by Alan R. Fusfeld in his analysis of "The Technological Progress Function" *(February, pp. 29-38).* An early response which is at once reassuring and perturbing comes from I. S. Servi of Kennecott Copper Corp.'s Ledgemont Laboratory:

"Your deviation from tradition is refreshing on two counts. First, it indicates your sensitivity to the power of quantitative statements; second, it indicates your confidence in the vitality and interest of your readers, irrespective of their age and present occupations."

Then comes Dr. Servi's observation that "an unfortunate printing error has added an unnecessary mathematical complication. On page 38, dt/T should have been dT/T."

Coming in May

When next you see a fire, watch the firefighters. You'll perhaps confirm the observations of Alan L. Frohman of Pugh-Roberts Associates, Inc., who writes that 19th century technology is here entrenched in the 20th century; of the fire-fighters' tools, only the truck is new.

A straightforward engineering problem may serve as a model for problems in the study of human perception, suggests William M. Siebert, Professor of Electrical Engineering at M.I.T. Engineers try to minimize the errors that signal detection systems make due to the presence of noise—random fluctuations in the signal. Is human perception designed to minimize similar problems?

Letters

Prairie Recollections

Volta Torrey's "Reminiscence at Christmas" (*December, pp. 12-13*) was so fine —it really got to me. Born and raised in Nebraska, rural Indiana and Iowa, I find his recollections ring true. In one way or another my early days had the joys of his, including the making of detector crystals by doping molten lead with a speck of sulphur.

And hearing Carl Sandburg tell stories and play his guitar 'till very late in our home in Nebraska—when he was somewhat short of cash and meal money. Thanks for the good words about doom —it's not here yet, and *we are.*

Robert Moyer
Vienna, Va.

Science and Arms Limitation

Dr. Tsipis' papers on strategic arms limitation (*October/November, pp. 26-35 and December, pp. 44-48*) display a belief in scientific absolutes usually reserved for convictions in the less mundane field of faith. The burden of proving the "invulnerability" of weapons systems, of "mutually assured destruction" strategies, and such particularization as "even two (Polaris submarines) constitute credible deterrence" requires limiting assumptions (hypothetical scenarios) incompatible with scientific rigor.

Everyone, in this country at least, honors the principle of arms control. Unhappily, conversion of desirable principles into attainable realities is unlikely to be advanced by extravagant claims presented as scientific absolutes.

Since war in all its horrors has ever been more an art than a science; since intentions (the enemy's no less than our own) weigh as vitally as "capabilities," American scientists have an awesome responsibility to separate their laudable humanitarianism and justified fears from their weapons' analyses. Let scientific prognostication remain scientific.

George Reinhardt
Santa Barbara, Calif.

Dr. Tsipis comments:

I agree with Colonel Reinhardt that intention as well as capabilities are germaine in any political conflict. The latter, however, impose absolute limits on the former, so one can arrive at "scientific" conclusions by examining technical capabilities which are based on the laws of physics. I suspect that my only quarrel with Colonel Reinhardt is that I differentiate between "truth" and "proveability" and he does not.

Forward by Force

George D. Ray's criticism (*"Leading Us Toward Anarchy?", December, p. 5*), suggesting the answer is "to work for change within the system," is historically and legally erroneous.

Dr. Ellsberg indeed worked for years within the system. He was a member of the task force which wrote the Pentagon Papers pursuant to an order from Defense Secretary McNamara.

I prefer the path of Jefferson, Adams and Franklin over that of Mr. Ray. They wrote the Declaration of Independence because of a decent respect for the opinion of mankind, and by resisting King George III by force and violence, they took a giant step forward for humanity.

In the present issue—the subject of my original letter (*July/August, p. 4*). I called for lifting the curtain which veils the operations of Atomic Energy Commission. The A.E.C. arrogantly ignores the public's right and need to know. This interferes with the democratic process and endangers the lives of all of us—even the lives of yet unborn generations.

The country needs another Dr. Ellsberg to shed light on the A.E.C.

Moses Cammer
Larchmont, N.Y.

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Battered Blue Table in Science's Hall

Washington Report
Victor Cohn

It was a scratched and battered blue tote table with folding legs and a bedraggled look. A Salvation Army store would never have put it in the window without a heavy coat of paint. Yet it stood and served stoutly for a day and a half in a foyer of Washington's Sheraton-Park Hotel as a symbol of the annual year-end meeting of the American Association for the Advancement of Science.

It also—and I think this makes it important—represented a continuing challenge to every other professional society in this day of passion and change.

The leadership of the "Triple-A-S," whose registration foyer it was, would not have had it so. It was the year when they had hoped that youthful protesters—the kind who were manning the table—would dry up and blow away in recognition of the fact that the protest era of a few years ago has passed its furious peak.

The perhaps 60 or 70 young revolutionaries who harrassed the A.A.A.S. very emphatically did not blow away, and in this way they made of their shabby folding table a kind of Liberty Oak or even Bunker Hill.

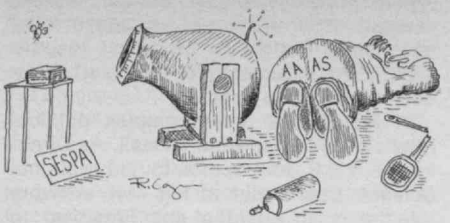
All this would still make a minor incident in the current history of protest and arrests except for two facts. First, the affair was created in equal part by the protesters and by an ill-considered A.A.A.S. response. Second, as Dr. Alan Nixon, President of the American Chemical Society, pointed out in an address at this Washington meeting: Scientific and professional organizations are still facing "a period of revolution of ideas and of mores," and "scientists, generally, have been largely indifferent" to it, at least until brought up short by the realities of unemployment and an increasingly so-what attitude of youth in particular, *but also* (italics mine) *of much of the public.*

Scientists and engineers, in other words, have still not adapted to the demands of the times. And this is not a young hothead saying it, but a gray-headed, largely moderate-conservative, business-oriented chemist.

There was every reason, of course, for the A.A.A.S. leaders to be impatient with their left-wing tormentors, who have largely been members or adherents of the loosely-organized group called Scientists and Engineers for Social and Political Action/Science for the People.

S.E.S.P.A. itself cannot say just how many members it has, since it has no officers, "spokespersons," or membership list as such. It does, said one spokesperson (though he refused to call himself that), have a mailing list of "about 1,000" for its bi-monthly magazine. It mustered less than 100 persons for the Washington meeting, judging by the number I saw assembled at the group's crucial December 26 evening meeting to talk out its response to the vacillating A.A.A.S. response to its little table.

The S.E.S.P.A. people do not, by and large, represent the many young scientists and science students who believe that great changes should be made within our system; these moderates would far outnumber them. The S.E.S.P.A.s are the rebels who are opposed to the system



"... the affair was created in equal part by the protesters and by an ill-considered A.A.A.S. response."

and they thus both limit their own numbers and help create the dilemma that faces the organizers of any meeting that faces their presence: Shall we, forcibly if necessary, exclude them and trigger their charges of "dictatorship," or shall we admit them and face their disruptions?

The A.A.A.S. boldly and, I believe, commendably did the latter in 1969, 1970 and 1971. S.E.S.P.A. members manned literature tables and passed out their papers. If, as they maintain, they never "broke up" a single session of the meeting, they certainly disrupted many. In Chicago in 1970 they presented Edward Teller a "Dr. Strangelove" award and displayed cuttingly-worded polemics on either side of him as he courageously continued to speak. The threat of similar treatment prompted Dr. Glenn T. Seaborg, then head of the Atomic Energy Commission, therefore politically more vulnerable, simply to walk away and decline to appear.

The S.E.S.P.A. method of "questioning" at many A.A.A.S. sessions in 1971, their language and epithets—these were as disruptive on several occasions as the tomato that was tossed from their group at Senator Hubert H. Humphrey.

Groaning Boards

It is understandable, therefore, that the A.A.A.S. Board of Directors, chaired by Mina Rees, decided early last year that it would no longer provide table space or other accommodations to any groups that were not A.A.A.S. affiliates. And S.E.S.P.A. would not become a A.A.A.S. affiliate, nor would it seek to place its own speakers or content itself with organizing its own forums as its contribution to A.A.A.S. discussion. Such acts, it maintains, would make it too a part of the "corporate-military-imperialist" structure into which it places the A.A.A.S. and by implication almost every other scientific or technological society.

All right, the A.A.A.S. told S.E.S.P.A. by formal letter, no table or meeting rooms at the Washington sessions. And Dr. Rees warned in a December 15 editorial in *Science,* "We welcome participants who use the meeting to bring ideas into confrontation; we condemn acts that deny others the opportunity to present their views or to engage in dissent . . . We shall take whatever steps we can to prevent this kind of interference."

So clear a warning of possible arrest is, of course, an irresistible invitation to the children of our time who are aware that only violence and arrests are certain to engage the attention of the media in these clamorous days.

Came December 26. The "Science for the People" people put up their table and blanketed it with their literature alleging that both U.S. science and the A.A.A.S. were the "tools" of the corporate rulers. A.A.A.S. Meeting Director Richard Scribner asked the group to leave. They stayed despite the menacing presence of police and security guards.

Reporters watched. Dr. Scribner retreated. The table remained, and later in the day a tired-looking Dr. Scribner reappeared to offer what the A.A.A.S. Board and Dr. Rees had previously denied—a place for their table in a special "interaction area," where it would be accompanied by the tables of consumerists, environmentalists, and others who wanted to engage the attention of A.A.A.S. meeting-goers.

The carefully considered A.A.A.S. position had, in short, quickly been tossed out the window for one that might have prevented the problem in the first place. The problem now was that the only available interaction area seemed to be two flights down from the Sheraton-Park lobby and registration foyer, in an area traversed by few A.A.A.S. members or anyone else.

"We're not exactly overwhelmed by your generous offer," said S.E.S.P.A. member Allen Weinrub, an unemployed Harvard Ph.D. in physics, who was an Assistant Professor at Boston University until, he says, "I gave them quite a lot of trouble."

The table was in the registration foyer again the next day, December 27. A.A.A.S. leaders kept their own counsel, but in late morning, suddenly, a police squad appeared, and A.A.A.S. official Howard Greyber, followed by the hotel security chief, followed by a police captain, asked the entabled S.E.S.P.A. people to fold up.

They did not. Police and security guards moved in and began pulling them away. They resisted, and there were scuffles and pulling and hauling as the police were forced to manhandle those they arrested through knots of shouting and shoving young men and women.

The first person arrested was James Whitney, an Assistant Professor of Physics at the University of Massachusetts. He got away. "The police got me halfway to the door of the registration area," he said later. "I was rescued by all these people."

Eight persons were arrested in all, with the most violent scene and the last group of arrests taking place in front of the hotel as the protesters hammered with their hands on the sides of the paddy wagon and harrassed the police. One young man was arrested as, to all appearance, he was bending down to let the air out of a police car's tires.

The Washington police are as well-trained and cool-headed in handling protests as any in the country—they have had enough practice—but a few, tired of the shoving and resistance and bitter name-calling, lost their heads and banged away some with their fists as they tried to make arrests. No matter how much

provoked, this is still police violence, and it incensed a watching M.I.T. Associate Physics Professor, H. Eugene Stanley. As he told this reporter, "I'm not a protester! I'm quite conservative. I was a position paper coordinator for Scientists for McGovern."

Came December 28. There stood that blue fold-up table again, groaning once more with literature—all with A.A.A.S. approval in a new, apparently mutually satisfactory interaction area, only one flight down from the lobby at a place passed by hundreds on their way to and from A.A.A.S. sessions.

What will happen in the future? The interaction area would seem to be an inspired idea. The A.A.A.S. Council (or representative body) later in the week refused to assure S.E.S.P.A. future space, despite a plea from Garland Allan of Washington University in St. Louis.

But is is hard to believe that a pattern has not been set, and one that could permit both confrontation and the orderly conduct of a meeting. This is providing that A.A.A.S. Board members do not again insist that it is "our meeting and we must control it," in the late twentieth century an impossible goal. And providing that S.E.S.P.A.s and others who state their cases with passion are willing to do it without the kind of vicious language and disruption that only destroys, does not build a democracy.

Victor Cohn, formerly Science Editor of the Washington Post, *now concentrates on major science-oriented reporting assignments for that newspaper.*

Diffusing Science from White House

J. Herbert Hollomon

In a sense the President's Science Advisory Committee and the Office of Science and Technology were not eliminated by President Nixon. Their formal structures were abolished but their functions have been diffused throughout the Executive Office of the President. The Director of the National Science Foundation has been charged with providing scientific advice to the President and to the Executive agencies and departments and in some ways to carry forward some of the panel activities of P.S.A.C. Other interests of O.S.T. apparently are being absorbed by the Office of Management and Budget and the National Security Council.

A question now is whether H. Guyford Stever, Director of N.S.F., can be expected to administer the Foundation, which obviously has a stake in overall science policy and allocation of science resources, and still be an unbiased advisor to other agencies and the President? This is not a unique problem in the President's plan. The Secretaries of the Treasury and Transportation, for example, have their narrow departmental functions together with broad Presidentially assigned responsibilities cutting across several departments. In a sense they have been assigned "program" responsibility. Arrangements of this sort have been made in the past.

Dr. Stever has other complex political relationships to sort out as well. As Director of N.S.F. he reports to the National Science Board. But in his new advisory role he is an agent of the President to whom the Board reports, at least indirectly. And I expect several powerful and trusted Cabinet-level voices will be at the President's ear proffering advice in scientific and technological matters. This seems to be how Mr. Nixon wants it.

It is obvious that a lot of people are upset by the changes. People who had been involved in the intricate White House advisory network take them to mean that the President has a negative attitude toward science and technology. Old political wounds were unnecessarily exacerbated by the sudden, confusing, and as yet unsettled shifting around of the advisory apparatus. There are objections that the Nixon Administration has a practical, short-range orientation that is harmful to the more fundamental development of science and technology.

Why the Change?

Conceptually something has changed in the coordination of scientific input at the Presidential level of the federal establishment. There are several reasons why it has happened, any one or all of which may be partly right. One it seems to me has to do with the President's style. I see Mr. Nixon as a person who likes to work with relatively few people upon whom he depends. This is an important point. It is the President's prerogative to organize his office as he wishes. He has four special counselors whose activities straddle many federal departments and agencies, an arrangement that may be consistent with the Ashe recommendations that the Executive branch be reorganized into fewer functionally integrated departments. These Presidential counselors are Secretaries Lynn (Housing and Urban Development), Butz (Agriculture), Shultz (Treasury), and Weinberger (Health, Education and Welfare).

They apparently will have responsibilities for "programs" of natural resources, human resources, communities, the economy and industry, and foreign affairs. Since science and technology pervade each of these areas it seems reasonable to think about diffusing to some extent the overall responsibility for science and technology as it relates to them.

A second argument has to do with the fact that the scientific and technological issues facing the country have changed over the last 20 years. I believe that P.S.A.C. and O.S.T. did not adapt well to those changes. They were established to bring science to bear on some major problems facing us after World War II—the Cold War, the Space Program, and to some degree biological research relating to disease. Starting in the mid-1960s, the Kennedy and Johnson Administrations began responding to human welfare and social problems in new ways.

The thrust into such problems as unemployment, urban blight, and health-care delivery systems involved non-traditional uses of science and technology. The problems were diffuse, spread all over the country. The limits of science in these areas have not been scientific limits, they have been chiefly political, economic, bureaucratic, and social. It is not so much now that the President and the Executive branch need advice as it is that we need to learn how to deal with the complex interactions of science, technology, and society. P.S.A.C. and O.S.T. simply lagged in changing course for whatever reason—the attitude of the President or his advisors or the inertia of the organization—and were finally opted out of existence.

A third factor that surely cannot be ignored in the hazardous world of politics is that many scientists took positions concerning the Cold War, the anti-ballistic missile, Vietnam, and the recent Presidential election that were contrary to Mr. Nixon's. In some cases, members of his advisory apparatus publicly took anti-Nixon positions. The rewards for this kind of independence are sometimes negative.

The Balance Quandaries

I would argue that we are out of the era in which the primary technical resources were aimed at specific goals such as light and stronger materials, more powerful weapons, better engines, more powerful computers, more effective telescopes.

Times are changing. For example, we know how physically to design cities in order to have adequate transportation, heat, communications, and energy supplies. But that's not the question. The question is how to change existing cities so that people want to live in them, at reasonable cost, comfortably, humanely, having open to them a variety of social and cultural amenities. The changes involve finance, law, regulation, segregation, attitudes, and many other things that are nonquantifiable or not easily quantifiable.

To solve these kinds of problems we need new kinds of institutions more connected with the users. They have to understand the nature of the citizen, of the world in which he lives and operates. Changes are needed in the way we educate people who will work in the problem areas. And clearly the character of technical work is changing, making it more difficult and I think more interesting.

We are not in an either/or situation. Support for the advance of science and the technology that derives from it is not going to stop. It is more a matter of balance. We have to deal with national and local social problems and at the same time allocate our resources effectively to do so. The same old techniques won't work on both sets of problems. And that's a quandary. Neither the old attitudes nor the old institutions will work in dealing with these two sets of problems.

I am convinced that educational institutions are going to have to find ways of dealing with two sets of seemingly antithetical issues: How to conserve the attitude of open and free intellectual inquiry and to advance the state of knowledge; and at the same time how to apply educational resources to multidisciplinary, problem-oriented questions.

One possible outcome of the President's science advisory alterations is that the scientific community could lose its special representative at the highest governmental level. That could take us back to the pre-World War II period— I suppose the pendulum could swing that far— when few agencies knew how to use science successfully.

Recouping Congress' Powers

It apears that Congressional ire has rarely been more deeply aroused by the Executive as a result of the various Presidential initiatives that appear to have pre-empted some of the Legislature's prerogatives. It seems to me that the Congress is not organized to look at their own actions collectively, to make tradeoffs, to consider the consequences of their legislation. This has only been done on the Executive side. And the argument seems to be that since the Congress is unwilling to weigh the effects of its legislation the President will step into the vacuum, reorganize his side of the government, and make value judgements and decisions on enacted appropriations no matter what political or Constitutional questions are raised.

I think it is important for Congress to restore the balance of powers. But it can do that only with more current and substantial data than it now gets.

There is no place in the Government— with one modest exception—in which the overall strategy policies having to do with technology and how it interacts with the industrial, economic, social, and political environments is well supported and well thought out. One modest program in the N.S.F. that has been in existence less than a year, is charged with helping to develop a science and technology policy for the country. But the activity is not enough to provide adequate input into policy decisions of such importance.

The Congress has established the Office of Technology Assessment (*see pp. 39-48 of this issue*) to help the Legislature examine issues relating to the secondary effects of industrial and economic development. It is aimed at strengthening the Congress' ability to make laws. If it is well done and becomes well supported it could tip the balance a little toward the Congress in being able to contest with the Executive branch on the basis of more substantial information than it has ever before had.

My greatest concern about the technical advisory apparatus that has been dismantled is that there is no clear evidence that anybody knows what is going to replace it to deal with the central problem of science and technology and their societal applications. I am deeply concerned about how to correct past distortions in the allocation of technical resources that have affected how we can use technology for any other purpose than defense and space.

In the new order of things I don't see clearly who is going to perform the tradeoff function with our finite pool of technical resources. I suspect it might be done by the N.S.F., but it would be a new kind of activity for them. Whoever does it will have to do it better and more sensitively than it has been done in the past.

J. Herbert Hollomon is Director of M.I.T.'s Center for Policy Alternatives; he has earlier been Assistant Secretary of Commerce for Science and Technology and President of the University of Oklahoma.

From P.S.A.C. to Capitol Hill

Howard J. Lewis

January is the two-faced month, a month to look before and after. There are those who argue that the usefulness of the President's Science Advisory Committee (P.S.A.C.), which has been disbanded to the lamentations of many U.S. scientists and engineers, had ended almost a decade ago. It was an excellent device to enable an administration to reach into the scientific community for guidance, they say; it was not, however, reversible any more than one can push a string.

Others date its demise to the decision to broaden its membership for purposes of representation. The earliest committees were composed of individuals from the old-boy network who worked together as

a highly professional team. But when attention was called to the narrowness of the membership, both in terms of geography and discipline, conventional wisdom called for reconstituting its membership to include the social sciences, industry, and all the other sectors. What was not so apparent was that P.S.A.C. was not a parliament and could not be a lobby. Far more representative of the scientific and engineering capabilities of the country than its predecessor, the new P.S.A.C. was admirably prepared to perform a set of tasks that it would not be asked to do.

In hindsight, one can see another seed of destruction. Somewhere in the course of its history, P.S.A.C. began to live up to the early intentions: it began to advise the President within the walls of privilege. Earlier P.S.A.C. reports were published; in the new scheme P.S.A.C. studies were delivered to the White House only. And as they came to deal more and more with problems that were at least as political as they were scientific they came more and more to diverge from what the current occupant of the White House saw as the national interest. Thus did two lifestyles come into conflict.

The operating rules now current call upon presidential advisers to maintain absolute secrecy on internal differences. As one science adviser said, "Why should the President turn all that ammunition over to the opposition?" It is difficult to believe that such procedures would not impose unbearable conditions on academically based advisers. It is one thing to have your advice rejected; it is quite another not to be able to tell your colleagues upon completion of an advisory study that your conclusions were not represented by ensuing policy.

Nevertheless, it must be assumed that both P.S.A.C. and the President's Science Adviser who chaired it had some symbolic value to the scientific community. Will their disappearance be viewed as a major disaster or will it be regarded with sorrow, like the slow disappearance of a three-knot swimmer going against a four-knot tide? Much may depend on a related set of circumstances—the federal budget for Fiscal Year 1974, which foretells catastrophic cutbacks in federal support of research and development and is the first public announcement of all the budgetary impoundments that have already been made in the 1973 budget.

Moving the Power to Capitol Hill

If all the non-voting representatives of the scientific community within the federal bureaucracy disappear from view, and if there is indeed a sharp drop in funds for academic research and the training of scientists and engineers, which seems foretold by President Nixon's budget, then it will be interesting to see whether the great consumers of public research funds quietly retrench or whether they seek other venues in which to plead their case.

Since the public in its wisdom continues to provide this most powerful administration with an opposition Congress, one might predict a natural swing toward Capitol Hill. So, apparently, does the administration. One recently departed official of the Executive Office hazarded the guess that the administration, unhappy with the tendency of the Congress to appropriate funds in excess of the President's budget, would offer what is in effect a "counterbudget," a budget especially devised to make more visible the gap between what the administration wished to spend and what the Congress appropriated. This is to provide a satisfactory political base to the administration for a subsequent tax increase. If such is the case it could very likely provide a powerful suggestion to the research community to shift its attention from the Executive agencies to the Congress as a more promising source of support. Take a Congressman out to lunch this week.

Much too will depend on what happens in the Congress. Recent moves by the Nixon administration have greatly consolidated its authority over individual departments and agencies. Among these are the subordination of departmental heads under larger groupings (Will Agriculture Secretary Butz really be responsible both for agricultural production and protection of wildlife?); designation by the White House of second-echelon officials in the agencies; and so forth, including a recent announcement that the White House would also designate senior press officers within the agencies. In the face of such massive centralization of federal power within the White House, the capacity of the Legislative branch to check and balance will be sorely tested.

It will also tend to focus the spotlight on a few key individuals. The future role of Senator Edward M. Kennedy (D.-Mass.) in this regard is especially worth pondering—because of his close links to science policy. Let us suppose, for instance, that his National Science Policy and Priorities Act, already reintroduced into the Senate, goes through in both houses with no substantial changes. As Chairman of the Special Subcommittee of the Senate Labor and Public Welfare Committee, which is responsible for authorizing programmatic activities of the National Science Foundation, Senator Kennedy would be in a position to influence a significant portion of nonmedical basic and applied research in the U.S.

When the Congressional Office of Technology Assessment is funded—presumably in the late spring—he will as Chairman of the Technology Assessment Board be in a strong position to oppose large components of technological research. In the dipolar world of Washington it is assumed that O.T.A. will serve as a nucleating force for political opposition to the White House in the area of research and development. Should Senator Kennedy thus end up with one foot on the accelerator and the other on the brake it would be difficult indeed to deny the image of the Senator in the driver's seat. It remains to be seen (1) whether the House leadership will be content to accept a secondary role and (2) how much gas there is in the tank.

Howard J. Lewis' comments on the President's Science Advisory Committee and the future focus of national science policymaking are drawn (with permission) from his article, "January Is a Two-Faced Month," in Public Science Newsletter *for January. (The Newsletter, of which Mr. Lewis is Editor, is published by the M.I.T. Press under supervision of the Science and Public Policy Program of the M.I.T. Department of Political Science.)*

Lost Horizons in the Desert West

Carle O. Hodge

Not long ago, mention of the arid Southwest was likely to evoke images of cacti, pastel buttes, and an ambience so crystalline that the vistas seemed almost infinite. The cacti and buttes are still there, but it is becoming ever more troublesome to see them through the darkening haze.

Atmospheric pollution is hardly specific to the sweep of America beyond the 100th Meridian, but some deserts and semi-deserts prove to be peculiarly susceptible to stagnation of the air. This has to do with global-scale circulation patterns; many arid areas are that way because they lie at latitudes where dry, descending air predominates and inversions frequently occur.

Nonetheless, the inland West was one of the last regions beset by epidemic haziness of the lower troposphere. Louis J. Battan, a University of Arizona atmospheric physicist, has reflected upon the transformation. Dr. Battan first went to Tucson as a World War II weather officer. A New Yorker, he was unprepared for the visibility records that were posted at the airbase when he reported for duty. "I thought, '50 miles, 60 miles? Someone must have added a zero'."

Were he to arrive today, he might find his adjustment less traumatic—at least on occasion. A few years ago, Dr. Battan and an associate computed the days in Tucson when one could see at least 15 miles; there were about half as many such days as there had been a decade and a half earlier.

Hauntingly Beautiful—and Polluted

Because of an array of factors, visibility does not lend itself easily to quantification. Turbidity may be measured with greater precision, and it has been for Tucson and for Mauna Loa in Hawaii. When the residues from such phenomena as volcanic eruptions dissipate, the turbidity at Mauna Loa lessens. The turbidity in Tucson, on the other hand, has risen virtually without interruption.

Nearby copper smelters do not enhance the pellucidity of the largest two Arizona cities, although automobiles, aircraft, and the other manifestations of growth apparently contribute a larger proportion of the total pollution. Tucson and Phoenix, like Los Angeles, ,are hazier than

(*Continued on p. 76*)

discovery of a powerful family of hormone-like agents called prostaglandins, the mapping of human chromosomes, Nobel prize-winning insights into the causes of cancer . . . or a score of other fascinating achievements.

Our medical and paramedical technologies are leaping forward. Each year, each month, each day there are fewer limits on our abilities to diagnose and cure disease, alleviate suffering and prolong life.

Unfortunately, a tragic gap separates what we can do from what we *are* doing. As other articles in SCIENTIFIC AMERICAN have shown, our health care system, responsible for delivering the blessings of medical technology to the people, is shamefully disorganized, outdated and expensive—resulting in needless pain, physical damage and death.

Three years ago the situation was critical. This year it is intolerable. Next year it will be worse.

The need to do something about it is the growing health care crisis. Many of the articles may surprise you, perhaps even shock you. Like all SCIENTIFIC AMERICAN articles, they will bring you facts you won't find anywhere else . . . explain in advance problems that may make headlines months or even years from now . . . and do it all with unparalleled accuracy and objectivity. As usual, all the articles will be written by leading authorities who are directly involved in the issues they are discussing.

Modern health care, of course, is just one of the vital current issues SCIENTIFIC AMERICAN covers on a continuing basis. Pick any major subject area from race relations to national defense, from computer technology to the population explosion, and you're likely to find a whole string of articles running back 20 years or more—each a clear, meticulously documented, often prophetic analysis.

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(*Continued on p. 76*)

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Marvin J. Cetron
President
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Don H. Overly
International Research and
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Disagreeing with the Future

For all the attention given to future-forecasting in a planning-conscious world, the disparity between the layman's view of the future and that of the professional futurist remains large and intriguing.

Part of this disparity is easy to explain. The professionals have no monopoly on the painting of future-pictures. As long as people have kept calendars and made plans, there has been a market for such pictures—whether they be highly enigmatic (the prophecies of Macbeth's witches) or highly explicit (the football picks of Jimmy the Greek). Legitimate forecasters have always had to compete with a wide range of influences on public expectations.

In what turned out to be the final issue of *Innovation* magazine, we presented readers with a list of forecasts made by professional futurists: predictions of the environment, managerial issues, quality of life, and technology of 1980. We asked *Innovation's* readers—they were described by that magazine's editors as "leading executives in business and other organizations who are professionally concerned with the effective management of change"—to tell us if they agreed with the predictions.

This is a summary of those readers' responses. The results show that there is indeed a consensus on many issues, especially on technological predictions for the 1980s. But the results also show a striking—and potentially dangerous—lack of consensus about some of the most critical political and managerial issues likely to arise in the next two decades, among them the military role of the United States, the changing relations between government and business, the future of the free enterprise system, and the roles of women and blacks in business.

If there is potential danger in the disparities found in these areas, it is not because of reasonable differences of opinion about the likelihood that particular events will take place within a given stretch of time. Rather, the danger lies in the fact that two groups—the forecasters on one hand, and the business and professional community represented by *Innovation's* readers on the other—have apparently come to hold radically divergent expectations about the fundamental course of American life in the next decade. Since both groups figure to be major participants in the actual plotting of America's course, the possibilities for sardonic tragedy, should such disparities persist, are obvious. At worst—making the awkward assumption that *Innovation's* readers have about the same expectations as decision-makers generally—the next ten years could see most decision makers flying as blind as ever—but much faster—while forecasters play the useless role of backseat driver. At best, much of the decision-making community could be setting itself up for some rude surprises.

The questionnaire designed by Marvin Cetron and Don Overly and published in *Innovation* contained 74 hypotheses about life in 1980 or 1985. Each hypothesis describes an event which is postulated to take place by a specified year. Respondents were asked to indicate:

☐ Whether they agree that the event will occur as stated;

☐ Whether they agreed that the event is desirable; and

☐ Whether, if they disagreed that the event will occur as stated, their reason involved technical unfeasibility, economic unfeasibility, or social or political unacceptability.

For responses to the first two alternatives, the questionnaire gave respondents a way to indicate complete agreement, agreement except for the date of occurrence, agreement with minor reservations, or complete disagreement. In our charts and discussion, we aggregate "complete agreement" and "agreement with minor reservations."

The 74 hypotheses or events were selected from a data bank of recent forecasts in business, technology, economics, and social and political affairs. Most of the forecasts were the result of a method that produces a systematically refined consensus of expert opinion. The selected events include both "general" events (having to do with the business and political environment and the quality of life in the United States) and "technical" events (having to do with transportation, communication, energy, and materials). Respondents were instructed to answer as many questions as possible in the general category, but to answer questions in the technical category "only if you work in the technical field cited or consider yourself otherwise knowledgeable on the topic."

Here is a summary of the views of over 400 American business leaders who were readers of *Innovation* magazine.

Marvin J. Cetron founded the firm of which he is now President after a 20-year career in research and development planning and forecasting with the U.S. Navy. He is widely known as author and consultant and is Editor-in-Chief of *Technology Assessment.*

Don H. Overly is an economist (B.A., M.A. Wayne State University) with special interests in urban economics and public administration, technology assessment, and policy planning.

The data banks of both authors' firms were used to develop the events to which responses are analyzed.

Decision-makers are inclined to agree with futurists on the technology of the 1980s. But they disagree sharply with political and managerial forecasts—and that may mean trouble.

Government and Business in 1980

Respondents were in general agreement with forecasts that government will play an increasingly dominant role in American life and business. For example, out of a total of 400 valid responses, only 11 per cent disagreed with the statement that, in the business environment by 1980, "most of the institutions that meet broad public needs, such as health, transportation, communications, and energy production, will be joint public-private enterprises" (54 per cent agreed either completely or with minor reservations, while 34 per cent agreed except for the date, thinking it around 1990). Similarly, 54 per cent agreed with the forecast that by 1980 "antitrust actions will enjoin corporations with more than 25 per cent of the market, except for public utilities" (another 11 per cent figured these actions would take place by 1990). These forecasts and responses are consistent with projected increases in the services sector of industry (with which government functions are more likely to overlap or converge) in contrast to goods production.

Respondents appeared to agree with forecasts that the relationship between government and business (or between the public and private sectors generally) will not be a happy one in coming years. One item shows a remarkable 87 per cent of the respondents agreeing with the statement that "from now until 1980 there will be growing and visible dissatisfaction with government by all sectors of society."

Yet both the forecasters and the respondents expect the American government of the 1980s to carry on its long tradition as a benevolent institution, both in its relations with other governments and in its domestic relations with private citizens and businesses. Despite the ambiguous role of the U.S. in Vietnam, a fair reading of the responses would suggest that the U.S. government is viewed as likely to pursue a peaceful, cooperative role in international relations and a generally tolerant (albeit increasingly mothering) role in domestic affairs. Thus, a large majority of respondents agree with forecasts that "the U.S. will have amicable trade and aid agreements with the Common Market, Russia, and China"; that "there will be new and effective government-run manpower and retraining programs to reduce significantly the negative effects of technological unemployment"; and that "income maintenance programs will assure a scale of living equivalent to $4,000 per year in current dollars for a family of five living in urban areas."

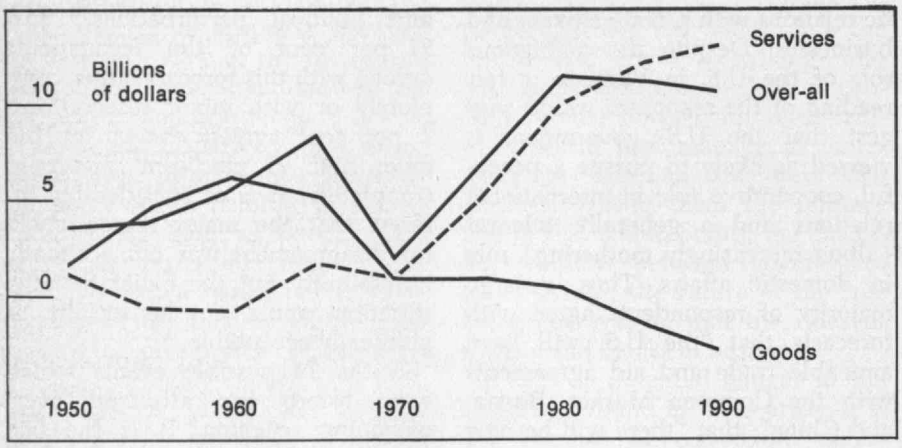
Perhaps the majority of respondents are lulled by this sense of the benevolence of the American government; perhaps they view dissatisfaction with government as little more than a curious American condition—something which will always be with us, which may become more exacerbated than ever in the coming decade, but which is not really incompatible with the fundamentally laissez-faire attitude government has assumed in its relations with private business. There is evidence that the strain between the public and private sectors may be somewhat greater than the majority of respondents expect.

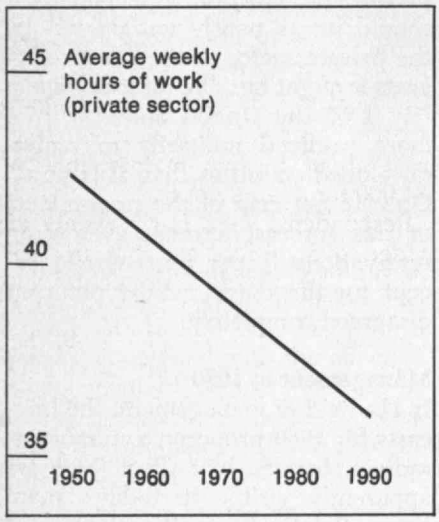
The forecasts show several pictures of the future that the respondents are unable to accept. A prime example is the statement that by 1980 "government policy concerning pollution will bankrupt firms in major industries, causing major economic and political perturbations." Just 21 per cent of the respondents agreed with this forecast either completely or with minor reservations; 2 per cent agreed except for the date; and 77 per cent disagreed completely. It is of considerable interest that the major reason given for disagreement was not economic unfeasibility but the belief that the situation would not be socially or politically acceptable.

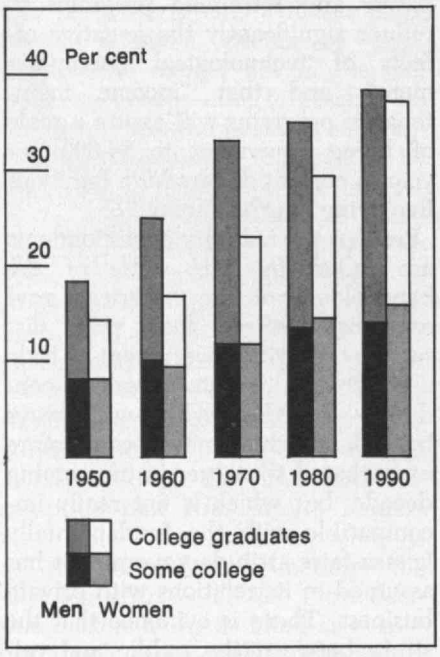
Of the 74 possible events which were listed, one attracted overwhelming rejection. It is the one which could cause the heaviest perturbations of all, especially if it should be as poorly anticipated by the private sector as the survey suggests it might be. The forecast reads: "By 1980 the United States will be more involved militarily in underdeveloped countries than it is now." Only 15 per cent of the respondents to this forecast agreed, even with reservations; 1 per cent agreed except for the date; and 84 per cent disagreed completely.

Management in 1980

In the field of management, the forecasts for 1980 proposed a number of radical changes. Not all of them are apparently visible to today's managers. Relatively small majorities of respondents agreed with forecasts that by 1980 "it will be almost routine for executives, engineers, physicians, and other professionals to go back to school for advanced training every two or three years" (50 per cent agreed, with 34 per cent more agreed except for the date); that "it will be almost routine for a professional to have changed careers at least three times during his working life (68 per cent agreed, with 15 per cent more agreed except for the date); and that "the bulk of







Factual corroboration of some of the *Innovation* questionnaire's predictions. Top chart: Forecasts by the U.S. Department of Commerce and The Conference Board of growth in the services sector of the U.S. economy in the remaining years of the 20th century are consistent with the predictions of an increasing role for government in meeting "broad public needs" and an increasing impact on all industry of antitrust actions. Lower right: The professional forecasters proposed that by 1980 "nearly 45 per cent of all middle managers will be women." Though *Innovation* readers were skeptical, this forecast is consistent with projections of the growing numbers of women who will have college experience and college degrees in the 1980s and 1990s. (Data: Departments of Commerce and Health, Education and Welfare) Lower left: Essentially everyone is agreed: ". . . the work week . . . will decrease by 20 per cent, with no loss in personal income . . ." The data shown are projections of the Departments of Commerce and Labor.

management will be of an internal consultative nature between employees, as opposed to participative or authoritarian" (42 per cent agreed, with 19 per cent agreed except for the date).

There is general agreement that American business will be much more responsive to its social responsibilities: 70 per cent agreed that "the corporate goal of long-term growth and continuity will become more important than short-term financial goals," and 14 per cent more agreed except for the date. And 66 per cent agreed that "most corporations will consider their social responsibility goals, such as policies affecting the environment (air, water, and attitudes toward conservation, recycling, etc.), in the same manner that they now consider short-term financial goals as well as their long-term growth and continuity goals"; 20 per cent more agreed except for the date.

Similarly, most respondents agreed that we can expect a continuing liberalization of management policies concerning the social responsibilities of businesses for their own employees. Forecasts predict that "Most companies will provide time off from work, with pay, to allow employees to become involved in civic and social problems" (64 per cent agreed, while 24 per cent more agreed except for the date); that "unrestricted time will be allowed, with pay, for all sickness and pregnancy, with an individual's job held open until he or she returns to work" (50 per cent agreed, while 18 per cent more agreed except for the date); that "most corporations will have a policy of hiring a minimum of 10 per cent of employees from minority groups and 1 per cent from disabled workers" (75 per cent

agreed, while 10 per cent more agreed except for the date); and that "95 per cent of all corporations will provide free health and major medical insurance, as well as life insurance policies" (68 per cent agreed, while 19 per cent more agreed except for the date).

Finally, there was substantial agreement with five statements about the changing trends in "quantitative management." Majorities ranging from 59 to 79 per cent (70 to 94 per cent including those who agreed except for the date) concurred that by 1980 "a total of 75 per cent of the major corporations in the United States will be using explicit, quantitative corporate objectives in their research and development planning, instead of the present 30 per cent"; that "a total of 90 per cent of those corporations with 25 or more employees will be using technological forecasting in their technical planning, instead of the present 69 per cent"; that "a total of 90 per cent of the corporations will be using quantitative models incorporating subjective judgments to aid in allocating resources, instead of the 54 per cent that now frequently use them"; and that "65 per cent of the corporations will be using quantitative scenarios (environmental forecasts) in their long-range planning, instead of the present 44 per cent."

One thing is not so visible to today's managers: the changing composition of their own ranks. In contrast to their liberal view of the coming changes in employee status, the respondents take a rather conservative view of probable events in the management world they are themselves likely to inhabit. Two forecasts, in particular, were decisively rejected. One states that by 1980 "more than one quarter of all entrepreneurs in profitable industries will be from black or other minority groups"; only 22 per cent of the respondents agreed and 26 per cent more agreed except for the date, while 53 per cent disagreed completely. The most frequently mentioned reason for disagreement was "technical unfeasibility." One interpretation of this response would be that many readers simply do not believe the minority population is large enough to account for a quarter of all entrepreneurs. (Actually, there are about as many businesses as there are adult blacks in the United States, which suggests that the event is technically possible but rather improbable.)

The second rejected forecast is that by 1980 "nearly 45 per cent of all middle managers will be women." This forecast is consistent with predictions that the percentage of educated women will continue to increase. In contrast to this trend are the survey results: 20 per cent agree with the forecast; 25 per cent agree except for the date; and 55 per cent disagree completely. Here, however, the most frequently cited reason for disagreement was the social or political unacceptability of the event. For what it is worth, the respondents made a fairly sharp distinction on this item between their own evaluation of the desirability of the event and that of the general population. While 61 per cent personally thought it desirable, many said the general population would find it undesirable.

The Quality of Life in 1980

Six events were listed as changes in the "quality of life" by 1980. Reactions to these were much like the reactions to events in the fields of government, business, and management. Only two quality-of-life forecasts elicited disagreement from a majority of respondents, but those two—like the rejected forecasts in the other fields—appear to involve issues of particular importance.

Majorities of respondents—between 60 and 89 per cent (or 88 to 95 per cent, including those who agreed except for the date)—concurred with forecasts that "due to tax increases for new government services, the average per capita disposable income will not increase as greatly as gross personal income"; that "both the work week and total years of employment will decrease by 20 per cent, with no loss in personal income"; and that "domestic population growth will have stabilized at less than 2 per cent per year," along with the previously-mentioned forecast about income maintenance at $4,000 for a family of five.

Respondents were fairly evenly divided over a forecast that in 1980 their will be "wide-scale mental and physical health problems because of increases in leisure time"; 46 per cent agreed, 5 per cent agreed except for the date, and 48 per cent disagreed. Among the dissenters, 77 per cent said they disagreed because the event would not be socially or politically acceptable!

Possibly the most interesting forecast in this group elicited the greatest disagreement. The statement is that by 1980 "there will be general dissatisfaction with the free-enterprise system." Less than half (42 per cent) agreed, 7 per cent agreed except for the date, and 52 per cent disagreed completely. It is interesting to compare this response with that to the previously-mentioned forecast that "there will be growing and visible dissatisfaction with government . . . " (87 per cent agree,

Some Likely Shockers:
The six forecasts respondents disagreed with most

Forecast	*Per cent who disagree completely*	*Per cent who agree except for the date*	*Per cent who agree either with or without reservations*	*Some possible consequences of failure to recognize forecasted event in time*
The United States will be more involved militarily in underdeveloped countries in 1980 than it is now	84	14	2	Liberal perceptions of America are numbed and replaced by cynicism and boredom (dictatorship mentality) or by individual and community defiance (counter-culture). Conservative perception of America are confused and reformed by rationalization, authoritarianism, and acquiescence.
Government policy concerning pollution will bankrupt firms in major industries, causing major economic and political perturbations	77	2	21	Panic clean-up measures cost surviving businesses heavily; cozy government-business relationship is shaken; new political alliance forms between conservationists and enforcement branch.
The college graduates most eagerly sought after by business will be liberal arts graduates, rather than those with specialized science or business training.	74	5	21	Financial support for education is misdirect by institutional benefactors; students are misdirected by guidance offices.
The period between 1975 and 1985 will result in major decentralization of the federal government	60	4	36	Influx of money and responsibility breeds corruption and confusion in outlying areas which are poorly prepared because of inadequate advance notice
Most companies will have reverted to a tighter, centrally controlled form of management	59	6	35	Middle managers who counted on building their own programs (or empires) find themselves annexed.
There will be little relative expansion in corporate research budgets, as most research will be conducted by the federal government	57	7	37	Large investments in research facilities are wasted

1 per cent agree except for date, 12 per cent disagree). Maybe this is a reminder of the general tendency among survey respondents to view changes of the next decade as in general superficial. If there are troubles ahead, the respondents seem more inclined to attribute them to a transient system—the government—than to a fundamental one—free enterprise.

Technical Events in 1980 and 1985

While forecasts of general events turned up substantial majorities of dissenters one certain subjects, the 21 forecasts of technical events turned up no sharp patterns of divergence, although there was a fair amount of moderately divided opinion.

Forecasted changes in transportation include a government-sponsored ground transportation tube for the Northeast corridor (by 1985); heavy reliance on V./S.T.O.L.-type aircraft for short-haul passenger traffic; pollution-free automobile engines of several types; exclusion of private vehicles from most major urban centers; and computer diversion of urban traffic flow. Many respondents were not satisfied with the specified dates for these events; the rate of agreement was in the rather low 32-to-56 per cent range, but the total percent of agreement, including those who considered the specified dates too early, was 61 to 89 per cent.

Forecasted changes in communication include a 25 per cent decrease in business travel and mail by 1980; replacement of the telephone by audio-visual communication by 1985; an increase in the cost of first class mail to 25 cents by 1985 and a simultaneous reduction of single-page facsimile transmission costs to the same level; the use of checkless methods for 85 per cent of all financial transactions by 1980; and the use of cable television in 80 per cent of all households by 1985. Agreement with these forecasts ranged from 48 to 69 per cent, and if those who considered the specific dates too early are added, agreement ranged from 73 to 89 per cent.

Forecasts in the materials field attracted somewhat more support from the respondents. Some 65 per cent agreed (and another 24 per cent agreed except for the date) that by 1980 "synthetic materials will capture a substantial share of markets for pipes in new residential and commercial construction"; 60 per cent agreed (and another 8 per cent agreed except for the date) that by 1985 there will be commercial production of molecules (insulin, etc.)

by organic feeding of living cells"; and 74 per cent agreed (and another 24 per cent agreed except for the date) that by 1985, highly sensitive photochromic glass usable for house glazing will be commercialized.

The most indecisive responses in the entire questionnaire were those given to forecasts in the energy field. Here there was neither substantial agreement nor substantial disagreement on any forecast but one: that "by 1980 it will become possible to extract oil economically from continental shelves at a depth of more than 600 feet" (83 per cent agreed, and 13 per cent more agreed except for the date). Four other forecasts depicted an elimination of the energy crisis by 1985 because of an increase in nuclear powered generating plants; the development of effective new techniques for converting low-grade fuels to power by 1980; the replacement of fossil fuels by synthetic hydrocarbons before 1985; and the use of geothermal or solar power systems in at least 25 per cent of all new homes by 1980. On each of these questions, the believers, the date-hedgers, and the unbelievers were divided into roughly equal thirds.

Some Sure Picks:
The five forecasts respondents most agreed with

Forecast	*Per cent who agreed*	*Per cent who agreed except for date*	*Per cent who disagreed completely*
Due to tax increases for new government services, the average per capita disposable income will not increase as greatly as personal gross income	89	4	7
From now until 1980 there will be growing and visible dissatisfaction with government by all sectors of society	87	1	12
There will be new and effective government-run manpower and retraining programs by 1980, to reduce significantly the negative effects of technological unemployment	84	14	2
By 1980 it will be possible to extract oil economically from continental shelves at a depth of more than 600 feet.	83	13	4
Income maintenance programs will assure a scale of living equivalent to $4,000 per year in current dollars for a family of five living in urban areas	82	13	5

The Desirability of the Future

Though the main significance of the survey is in the forecasting aspect—the concurrence or disagreement about the the likelihood of an event's actually taking place—there are some interesting observations to be made about the desirability aspect of the questioning.

First, the ratings of desirability clearly establish the respondents as being, in their own judgment, far from representative of the general population. On a number of items, a majority of respondents rated an event as personally desirable but unlikely to occur for reasons of social or political unacceptability. For example, in evaluating the event which reads, "The period between 1975 and 1985 will result in major decentralization of the federal government," 78 per cent of the respondents rated the event desirable yet 77 per cent of the majority who felt the event would not occur stated their opinion that it would be politically or socially unacceptable.

Second, the desirability response suggests that the overall attitude of the respondents toward the projected future is an optimistic one. In 62 of 74 cases, a majority—usually a large majority—of the respondents rated the forecasted event as desirable. In the technical section, every one of the 21 events listed was rated desirable by a large majority. The significance of this is ambiguous, since it might be a reflection of the survey-makers selection of events, the attitudes of *Innovation* readers toward things which are innovative, or the implicit trust of Americans in technological progress. But with respect to the latter, it is interesting to note that technical unfeasibility was rarely given as a reason for believing that an event would not take place by 1980 or 1985. The majority of respondents disagreeing that an event would occur cited social or political unacceptability (36 cases) or economic unfeasibility (24 cases); technical unfeasibility was cited in only 12 cases.

A final observation about desirability: the most undesirable events generally involve government policy. As the accompanying charts show, five of the six most undesirable events fall into this category. By contrast, eight of the nine most desirable events do *not* involve government policy in any direct way.

Significance of the Response

The *Innovation* questionnaire is more than a poll. Because of the nature of the questions, the responses can be useful data, particularly since the 74 forecasts in the survey are in effect either confirmed or challenged by them. Where the forecast is confirmed, the uses are self-evident. Where the forecast is challenged, the data may be useful in a different way—as a warning to planners that the subject in question may be a planner's pitfall.

Further, in at least a few cases, the lack of agreement may suggest hidden schizms in that stratum of American society which is most responsible for laying the groundwork for the future. What does it mean when a group of fairly sophisticated people who don't know each other are almost unanimously opposed, both in desire and in expectation, to a course of military involvement which a consensus of experts believes the country is likely to follow? What does it mean when the forecasters' indicators say there will be an influx of thousands of women into

Some Highly Undesired Events
The forecasted events respondents rated most undesirable

Forecast	Per cent who rated event undesirable	Per cent who rated event desirable
The United States will be more involved militarily in under-developed countries in 1990 than it is now	86	14
Government policy concerning pollution will bankrupt firms in major industries, causing major economic and political perturbations	84	15
There will be wide-scale mental and physical health problems because of increases in leisure time in 1980	81	17
There will be general dissatisfaction with the free enterprise system by 1980	77	21
There will be little relative expansion in corporate research budgets, as most research will be conducted by the federal government by 1980.	76	23

Some Highly Desired Events
The forecasted events respondents rated most desirable

Forecast	Per cent who rated event desirable	Per cent who rated event undesirable
The United States will have amicable trade and aid agreements with the Common Market, Russia, and China	95	1
By 1985, highly sensitive photochromic glass (photosensitive color-changing glass), usable for house glazing, will be commercialized	95	2
By 1980 the corporate goal of long-term growth and continuity will become more important than short-term financial goals	95	3
By 1980, new and effective techniques for increasing the efficiency of converting low-grade fuels to power will be available	93	4

middle-managerial positions in the early 1980s, while the middle managers of the 1970s say that it will not happen?

The implications of these disparities are convoluted, but they can at least be hinted at. On one hand, the disparities could turn out to be little more than large wrinkles in the methodology of the "survey." Obviously, the respondents to *Innovation*'s questionnaire are not a scientific sample of anything. On the other hand, they could tell us something important about the nature of the planning process.

It is hard for anyone who knows how the forecasts were made—by a process entailing a thorough response-feedback-response processing of the opinions of large numbers of people in the field—to take the forecasts lightly. It is also hard to take lightly a near-consensus on any meaningful issue by a population as informed yet heterogeneous as the responding readers of a magazine like *Innovation*. It is not inconceivable that there are wide drifts of misinformation in the air, not only around candy stores and street corners but in the offices and conference rooms where a few people make decisions that commit millions of people to broad courses of action. Mistakes can be—and have been—made on a grand scale. But more often, the penalties for failing to anticipate forecasted events are less grand than chaotic. Here are some of the possibilities suggested by the *Innovation* results:

☐ New political alliances are made possible by relatively sudden rifts between traditional allies. The rifts occur when one side fails to anticipate the changing role of the other.

☐ Red tape becomes tangled as major responsibilities shift faster than anticipated.

☐ Corruption and exploitation flourish as newly-tangled red tape creates many new loopholes.

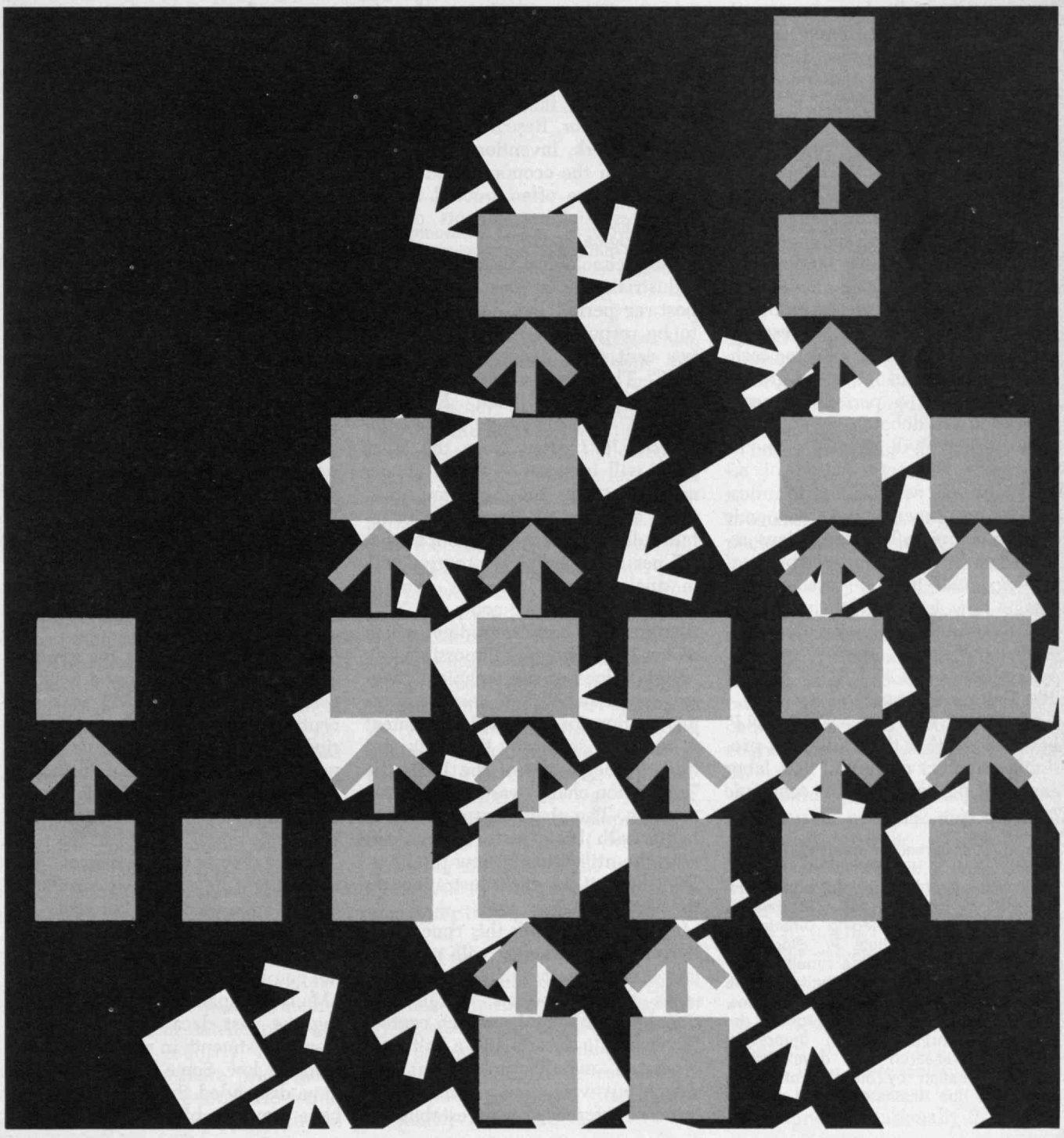
☐ Fraudulent institutions take over functions of health care, education, etc., because institutions traditionally entrusted with these functions fail to recognize changing social needs until it is too late and they have become obsolete.

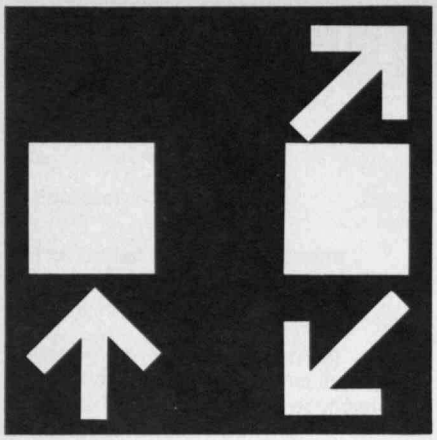
The Management of Innovation

The Innovation Process
Erik A. Haeffner

The Technical Supervisor:
Beyond the Peter Principle
George F. Farris

Venture Management and
Capital
Albert J. Kelley





The Innovation Process

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It once seemed almost axiomatic that more research should lead to more technical progress, since the natural sciences are the foundation of our industrial civilization. Yet no significant statistics or systematic empirical observations support the opinion that a close correlation exists between the volume of research and the number of innovations in an industry. To the contrary, inventions originating without association with research establishments have been cited as a major cause of industrial progress. Thus the use of research and development as a tool for technical progress and industrial growth is definitely in a period of reconsideration and debate.

This article will discuss a model describing the contribution of research as well as invention to industrial development and economic growth. Empirical investigations reported in literature and personal experience will then be used to envisage how an efficient innovation process should be composed and carried out.

The Faith in Research

Analyses of the increase in GN.P. have shown that the traditional production factors of capital and labor can only partially explain economic growth. The remainder is due in large measure to technical development, and therefore a third factor enters, which is usually termed the technological factor or technical progress factor. Research and development work, inventions, structural changes in the economy, and better education are often quoted as the most essential components of the technological factor.

The technological factor in several industrialized nations during the postwar period has been estimated to be responsible for more than 50 per cent of the increase in G.N.P. L. G. Thurow has found (*see "Research, Progress, and Economic Growth" in* Technology Review *for March, 1971*) that since the labor force will increase at about 1.5 per cent per year the economy must grow at about 4.7 per cent to maintain full employment. But out of that 4.7 per cent, technical progress will, in analogy with previous periods, account for 3.2 per cent, and it is therefore the basic ingredient which makes economic growth possible.

High values of the technical progress factor have often been taken as justification for increased investment in research, so during the 1950s and into the beginning of the 1960s the "innovation chain" was a popular expression. The chain was assumed to begin with basic research and end with the utilization of new products. We show it in the illustration on the opposite page.

In accordance with this conception that new knowledge will more or less automatically give rise to new ideas and products, large national governmental research centers (which for a decade and a half concentrated mainly on nuclear research but were then given broader terms of reference) were established in several countries during the fifties. At the same time, research councils were formed in different fields, mainly from people in academic life, with the duty of assessing applications and distributing research grants. State-supported industrial research institutes of various kinds were also established.

These supplemented the central R & D laboratories established by large industrial companies, which often employed academically qualified research workers as directors and staff. There were exhortations that more professors should be nominated to the boards of companies. In Sweden, special so-called development companies were formed to safeguard and utilize the results of research.

How is Technical Development Achieved?

Yet a correlation between research and development investment and G.N.P. increase may be held in doubt.

Figures given by Pout for some industrialized nations show a negative correlation between R&D as a percentage of the G.N.P. during the period 1950-59, and the average rate of growth of output per man during the period 1955-64 (the time lag is selected in order to allow R&D to bear fruit).

In fact, Pout's figures indicate that there might be a positive correlation in the same countries between economic growth and the proportion of qualified scientists and engineers *not* employed in R&D.

Many companies have noted during the past decade that the yield from investments in research departments is low. Some company boards have disbanded the research unit or have considerably cut the research

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Following a career in industry (Department Director of the Atomic Energy Company, Manager of the New Products Department of Incentive AB), Dr. **Erik A. Haeffner** became Managing Director of the Innovation Institute in Stockholm when it was founded by a group of scientists and engineers. The Institute offers interaction with industry in various forms, including joint ventures on product development, participation in theoretical studies of research and development, and specification by industry of needs for which the Institute is to develop products.

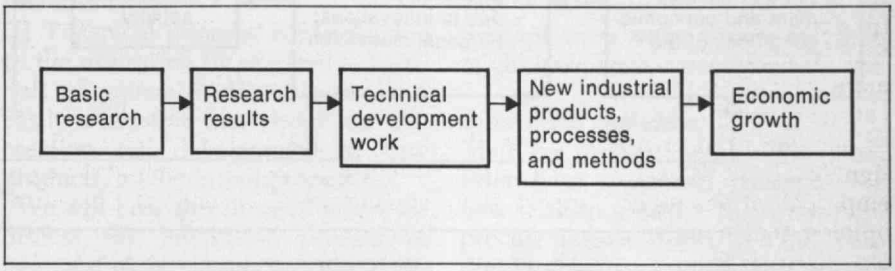
Most innovation is stimulated by the perception of a need to be met—not by pure research. If we understand the innovation process in that way, the innovativeness of industry might benefit.

budget. Others have announced that they will no longer spend money on "exotic techniques" but will find it more profitable to devote effort to a gradual improvement of their traditional products. Many companies are at present trying to find new models of how research and development is to be adapted to the objectives of the company.

Although we may not wish to believe that R&D is without effect on technical progress, we are certainly justified in asking the question: What causes industrial and economic growth?

Mainly due to American investigations, our understanding is clearing. Jacob Schmookler pointed out in 1962 that the theory of research being in itself a growth factor cannot explain either the time lag—often 10-30 years—between pure research and inventions, or the filtering which allows only some of the many potentially usable inventions to come to realisation.

The "innovation chain" is improbable because it presupposes that there is no dependence between the intensity or occurrence of technical development work (innovation activity) and the economic conditions in an industry. Schmookler assumed instead that economic conditions within an industry do govern technical development, owing to the relation between the expectation of ultimate financial gain, and the funding given to innovation efforts. He studied four fields of activity—railway companies, the paper industry, the petroleum industry, and agriculture—looking at capital formation and the number of patents per year. In the railway industry, he could also examine the share price index during a 100-year period. He found that during a century in which the railway industry changed from disordered to ordered conditions and from a growth to a decline activity, the frequency of patents faithfully followed the level of investment and the expected profit, as indicated by fluctuations in share prices. The same agreement was found in a comparison of the level of investment and the frequency of patents for petroleum refining companies and the paper industry, and agriculture as well, if consideration is given only to machinery patents and investments in agricultural machinery.



The "Innovation Chain," embodying the belief, popular in the 1950s, that new knowledge—the result of pure scientific research—would automatically lead to innovations in industry and economic growth.

But Schmookler could find no relationship between *research effort* and the frequency of patents; that is, scientific discoveries played no apparent role in the timing of significant inventions. It was obvious, however, that the development of the science of chemistry was a basic requirement for some important inventions in the paper and petroleum industries.

A Model for Technical Development and Economic Growth

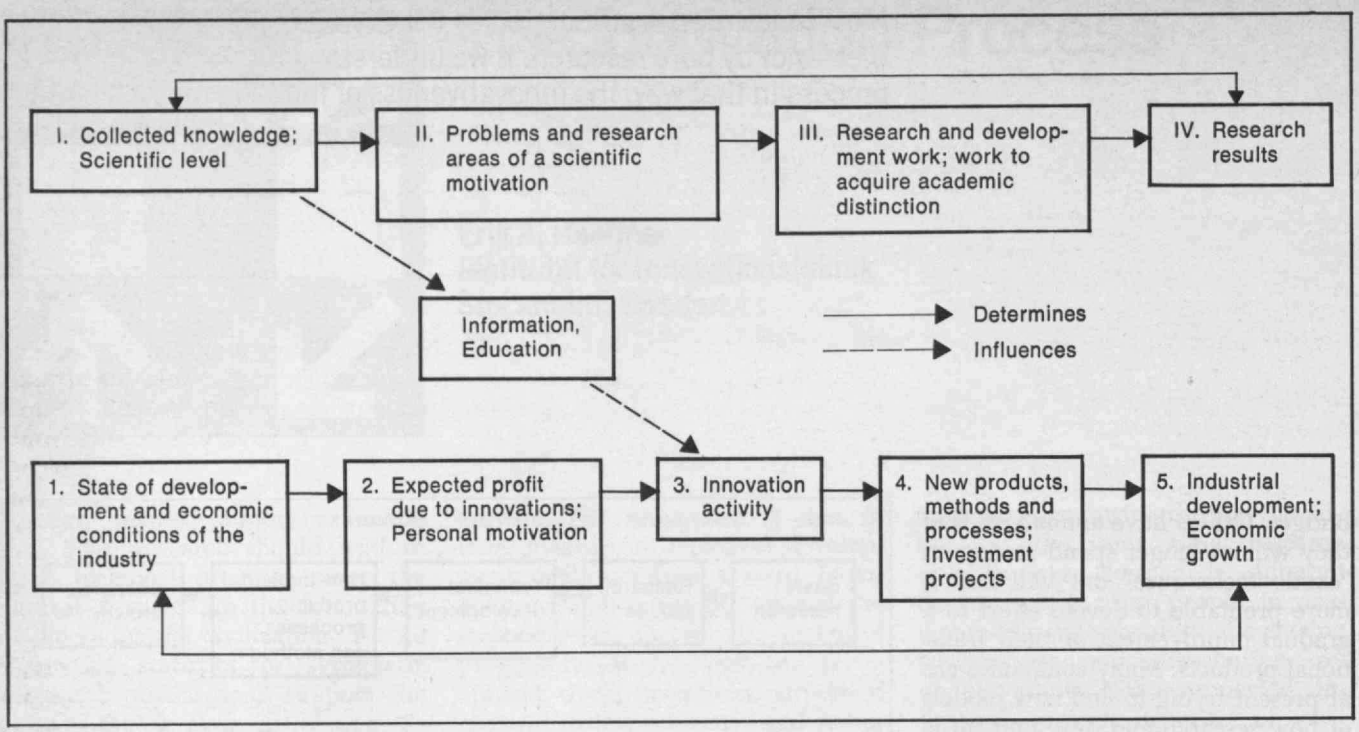
We have the following conclusions:

☐ Economic conditions in, and future prospects of, an industrial sector largely determine investments in invention activity and thereby the frequency of innovation.

☐ Research and development work appears to be an often needed but in itself insufficient condition for invention, innovation and industrial economic growth.

These conclusions can be embodied by a model in which innovation activity, and thereby also technical progress, are motivated by the expected profit, which is in turn determined by the state of development and the economic conditions in the industry. Research results in the form of scientific reports have the primary consequence that the body of scientific knowledge increases, but, by way of information and education, innovation activity is influenced. This model is shown on page 20.

It should be emphasized, however, that it is in actuality impossible to consign all scientific research to one "stream" (the top line in the illustration) and all technical work to another (the bottom line), allowing them to interact only in the dotted line that travels from the corpus of scientific knowledge to technical innovation. Scientific method is used many times in innovation work in order to seek information and increase knowledge relating, for example, to a process or a material. It also happens occasionally that a cre-



A model for technical progress and economic growth. The activity across the top of the model represents scientific research; the activity across the bottom represents development in industry. Research has one primary effect: it increases the body of available knowledge, and this knowledge affects innovation. The impetus to innovation, however, is the state of the industry, and the industry's expectation of profit arising from the effort. In the illustration at the right, "innovation activity" (box 3 above) is further dissected.

ative research worker makes a scientific discovery that is comparatively ready for technical or other application. Yet generally, scientific research according to the top line differs from technical development as represented by the bottom line in regard to motivation, method of working, objectives, and staff requirement. And the findings with which we opened this article do show that investment in large research laboratories and research staff is hardly suitable as a means of achieving economic growth, an experience which many industrial companies have had to face.

If the model presents a correct picture of actual conditions, then it means that only few innovations can be described as direct results of pure research and that the bulk of the inventions and innovations which are responsible for industrial growth occur in some other way. How does this accord with actual conditions? There is a surprising amount of evidence in support of the model.

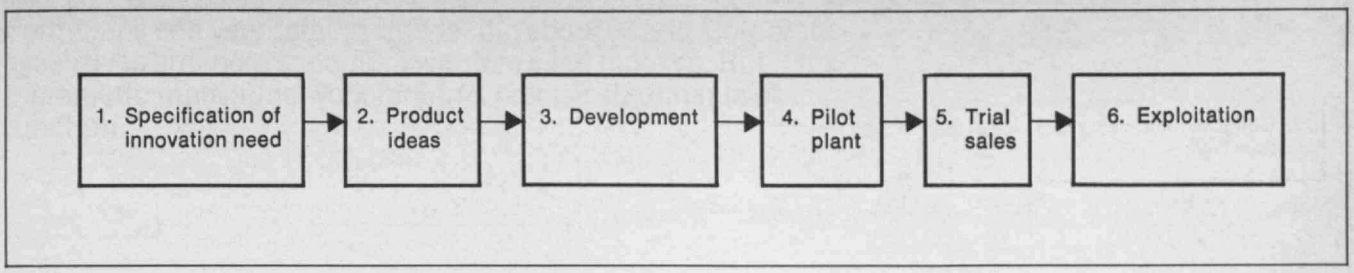
Irrational Innovation

Schon has studied the initiation and development of inventions in many different areas. He finds that an explanation of the birth of an invention as the result of conscious, rational research is often wrong. Innovation is in most cases an irrational process in which the invention idea appears first, and a completed product results after an often long and circuitous development route. Rational research is often employed at a later stage or as an aid in solving parts of the problems.

The same picture is provided by work carried out by Sjögren, who studied the product development processes at nine Swedish companies. He describes the innovation process as a search for information about an original idea, which either has arisen as a market requirement (in which case a technical solution has to be found) or as a technical idea which is looking for a market. Work progresses as an interaction between these two lines of attack until the product has been adapted to suit both the market and technology.

Two extremely interesting American investigations throw further light on the conditions required for technical development. Project Hindsight is the name chosen for an investigation that identifies and defines 835 significant innovations which came into being during the development of 20 distinct weapon systems. Only 5 per cent of this identifiable progress could be designated as the results of research in its proper meaning. The rest are the results of controlled innovation activity, 71 per cent of which had been initiated by *an identifiable need*—in this case need of a military nature. The direct significance of research on the achievement of technical objectives (which in this context often consist of extremely sophisticated components and systems with a high degree of reliability) is thus surprisingly low.

Information on civilian industries is given by an investigation by Myers and Marquis, who studied 567 commercially successful innovations from 191 companies in five distinct branches of industry. One third of these innovations were classified as modifications of existing techniques while the other two thirds were completely new projects. Most innovations (58 per cent) were characterized as products; the rest were processes (25 per cent) and components (18 per cent). Marquis mentions that the pattern which emerged as characteristic of commercially and technically successful innovations is surprisingly uniform, in spite of the fact that there are great differences between the industries investigated with regard to



structure, market and technology. I should like to repeat some of his findings. They are very important for our discussion.

The starting point of every innovation is an invention idea, which implies a new technical solution of a problem for which information can be obtained from different sources. It was found that 45 per cent of the investigated innovations were initiated as a consequence of a need noted in the market, 30 per cent as a consequence of production requirements of different kinds, while only 21 per cent could be described as the recognition of a utilisable technical possibility. Three-quarters of successful innovations can therefore be designated as having been need-stimulated—information which is of interest for product development efforts.

Marquis' investigation further showed that 46 per cent of the invention ideas originated in the experience and training of the innovator himself, 30 per cent in his personal contacts outside the company and 4 per cent in internal contacts. It is only in 3 per cent of the cases that the idea is identified as having been initiated by research.

The same picture emerges when the question is where the innovator obtains the information required for the solution of the problems that arise in the course of the innovation work once the original idea has been formulated. The results of the investigation show that the source of this information in 51 per cent of the cases was the training and experience of the innovator himself, in 18 per cent of the cases his external personal contacts, in 5 per cent of the cases internal contacts and in 8 per cent of the cases experiment and analysis, i.e. research.

Research played a minor role even during the stage of solving development problems. In three-quarters of the cases the information used by the innovators was generally available and was of a kind that is usually acquired in education, practical experience or personal contacts.

On the basis of the results of Marquis' investigation, we can formulate another conclusion to add to the previous two:

☐ Technical progress is mainly due to the utilisation by creative individuals of generally disseminated and easily accessible knowledge for the creation and development of new products, methods and processes.

We will bear this in mind when we discuss the innovation process in more detail, but for now we can observe that the findings reported by Marquis do not undermine the model of technical and economic progress on page 20.

Yet before we are satisfied with this model, it seems desirable to compare the invention yield for different organizations. If the model represents a true picture, then even very qualified R&D organizations should have a lower invention yield than many manufacturing and marketing industrial companies. Some figures to test this relation are presented in the table below. "Inventor companies" signify industrial companies which were originally founded by the inventor in order to exploit his own invention. "The Royal Institute of Technology" is the largest technical university in Sweden. "Atomic Energy Co." is a Swedish nuclear energy R&D establishment. "Industrial research institutes" are nonprofit organizations, specializing in different industrial sectors such as building, metals, wood and pulp, etc.; they are financially supported both by Swedish state and industry. The differences in invention yield appearing in the table are perhaps even more prominent than might have been expected.

Organization	*Number of patent applications per year per staff engaged in R & D*
Inventor companies	3.0
Minor Swedish companies	1.8
Major Swedish companies	0.3—0.7
Major U.S. companies	0.3
Royal Institute of Technology	<0.03 (estimate)
Atomic Energy Company	<0.02 (estimate)
Industrial research institutes	0.0—0.01 (estimate)

If the model shown at the top of these pages is representative of reality, pure research organizations should not be as innovative as industry, whose innovativeness is in response to needs in the market. The quantity of patent applications made by employees of each bears this out.

Innovation Activities

Thus far innovation has been considered as a general concept. We now wish to consider the innovation process in more detail. We therefore divide the content of the square labelled "innovation activities" in the model of progress into a sequence of activities shown above in order to describe innovation systematically.

Five natural decision stages appear:

☐ A choice between specified innovation requirements

☐ A decision to begin development of a product idea

☐ A decision to proceed with development work or to discontinue it

☐ A decision on trial production and trial sales

☐ A decision on exploitation

The person who makes these decisions must have knowledge and experience—in fact, partly the same ingredients as are needed for the creation of an idea—in order to make the correct decisions, and to dare to invest in a new product. It is important if innovation activity is to produce a return that great attention be paid to creative ability when se-

lecting leaders for development work. Luckily, creative individuals are to be found in all areas, as well-qualified scientists, company directors, bankers, economists and politicians, to name some categories which are often charged with the task of making decisions. This is an important point, since in larger companies innovations are usually exploited by means of an interchange between a lower level of power which proposed, and a higher one which decides. Creative contribution is required both when the invention idea is born and when the decision is made to invest money on its utilization. At an early stage during the innovation process it is impossible for a decision to be completely based on rational considerations, and a subjective judgment is required. It is then not surprising to find that the more creative the person who makes the decision, the greater is the yield from commercially successful new products—to express it in a positive manner. Placing creative people in decision-making positions is obviously important in order that a company—or any other organization engaged in technical development—should be successful in its innovation activities.

Identifying Needs

We have found that most commercially successful innovations are stimulated by necessity—that is, they are initiated by the discovery of a market or production requirement —while only about a fifth can be seen as resulting from the discovery of a technical possibility. Even for this fifth, the person who is to decide to invest money in a new product idea must believe that the product will have success in the market. Correct assessment of the need is of fundamental importance, since launching creative forces on formulating a new product for a specific need which is then shown not to exist or to be of a low intensity is obviously a waste of both labor and money. The first stage in the innovation process is consequently the correct definition of the need for innovation.

Let us suppose that the need can be represented as dependent upon three parameters: function, environment and economy. A new car engine or a new house must perform certain functions, and satisfy certain economical requirements and environmental requirements (these last are taken into account lately). The three parameters can be defined with different degrees of precision in order to express a product requirement. To illustrate this, we introduce the concept of the *degree of specification*. As an example, we can give eight degrees of specification for the parameter of function:

☐ Degree 0: Technical development is necessary.

☐ Degree 1: Technical development is necessary in a certain specified area; as an example, we will use building technology.

☐ Degree 2: Development is necessary in a specific aspect of building technology; e.g., better and cheaper building materials are needed.

☐ Degree 3: A specific new building material is needed: e.g., flooring materials, wall materials, roofing materials, acoustic materials, etc.

☐ Degree 4: An existing product with a specified single function must be improved; e.g. a partition wall with increased sound insulation.

☐ Degree 5: A previously unknown product in a specific area must be created, e.g. prefabricated exterior wall section with integral heating and ventilation equipment.

☐ Degree 6: The idea for a specific new product with detailed qualitative functions must be realized.

☐ Degree 7: The idea for a specific new product with detailed and quantitatively indicated functional requirements must be realized.

It is hardly possible for political authorities to proceed further than degree of specification 0 or 1. Government advisory organizations of different kinds may be regarded as the attempt by politicians, with the aid of representatives from different areas of research, to determine and rank R&D requirements in special areas, i.e. degree of specification 1.

Degree of specification 2 is the level at which, for example, a corporation's directors act when they decide, on the basis of experience or as a result of studies, to invest money in the development of new products in a certain area. Decisions of this kind are made naturally and with expert knowledge when they relate to one's own industry, but it is more difficult to define need in the event of corporate diversification or corporate embarkation upon development work in a new direction, on some new activity.

Industrial research institutes, institutes of technology, and major companies often make statements of need on levels 3 and 4 as the reason for their R&D activities. Statements of need by marketing experts and sales departments can be expected to be at the same levels. The opinion has been voiced that the marketing department should control the R&D activity of a company. But if this happens, the results of development work will be confined mainly to improvements in existing products.

It is often found that level 5, which generally requires creativity, is the

Politicians can very seldom be specific about needs. Corporate executives are more specific; inventors even more so. But systematic innovation work requires precise statements of function.

degree of specification which independent inventors use as the need-related impetus to the creation of new products. The independent inventor's dilemma is often that the need he works to meet cannot be carefully ascertained before he has devoted much labor to his project.

Finally, statements of need according to degrees of specification 6 and 7 are what is required for systematic innovation work. In order that needs may be stated in such a concrete form, a wide-ranging analysis of functional requirements is necessary.

In a similar way specific requirements must be laid down as regard economy and environment.

The probability that a result of value from the standpoint of industrial growth will be reached is greater the more precisely the need is defined—that is, the higher the degree of specification that can be attained. This seems almost an axiomatic statement, but nevertheless it is not generally recognized as a basis for industrial R&D. Needs expressed on levels 0-4 tend to produce research results of an increasing degree of applicability, but it is not until levels 5-7 have been attained that there is a greater probability of inventions and innovations.

Too Many Ideas

Creation of ideas is often said to be a process with a low return. American and British national organizations, which hand out grants for the development of inventions and ideas, report that 10-30 per cent of the product ideas received may be developed into a patent, but only 0.5-3.5 per cent will result in some form of return. According to Bedrosian, the goal in innovation work conducted on a profitmaking basis should be that 50 per cent of the ideas after the need has been identified should be good enough to proceed further to the next stage in the innovation process.

Representatives of industrial research often say that there is no shortage of ideas, that on the contrary, there is an overabundance of them, but that only a few per cent are worth developing further and even fewer will yield a return. Supporting this, the frequency of innovations is often found to be low in companies which say that they have too many ideas.

The low proportion of useful ideas is unsatisfactory for profitable innovation work. There are two steps, however, which may substantially improve the situation: a systematic creation of ideas should be based on a definition of need that lies in degrees of specification 6-7, that is, they should be based on functional requirements; and creative individuals should be chosen for innovation work.

It may be thought that this second step is self-evident, but an examination of a large number of advertisements seeking staff for industrial R&D shows that creativity is seldom stated as a necessary qualification. The requirements usually specified are a certain kind of education, previous experience in the area of technology in question, and then the ability to get on with people, initiative, knowledge of languages, etc. Nor is there apparently any demand for creative ability when grants are given for technical research or development.

The probable reason for this state of affairs is that education and academic qualifications are regarded as a criterion for creative ability. An investigation by Shockley shows how misleading this is. He found that people with similar educations employed in the same research organization, compared with regard to the number of patent applications they make, vary by a factor of practically 50, while the difference in the intelligence of people with the same research training will probably vary by a maximum factor of 1.2. The range of creative ability between different individuals of otherwise similar standards is thus very wide.

It should also be mentioned in this context that, according to recent investigations, creativity seems to *increase* rather than decrease with age, at least up to retirement, in people engaged in work of technical innovation. This phenomenon does not appear unlikely when we remember that previous experience, as shown by Marquis and Myers, plays an important part in the genesis of invention ideas.

Exploitation of New Products

Within a company, exploitation can take one of these two paths:

☐ If innovation work is planned as we have indicated, with a decision made prior to every stage, and continual adaptation of the developing product to marketing need, the decision whether to go into production need not entail any major mental anguish on the part of the company management.

☐ The situation will be different if invention ideas from R&D at a low level must be put to gradually higher levels of power within a company, making use of specialists and marketing experts to make the necessary assessments. There is a tendency for such assessments to be unfavorable, the more so the younger the idea.

We might parenthetically mention

other methods of exploitation that are not confined to the company:

☐ Selling a license to another company.

☐ Joining forces with another company which is interested in the project.

☐ Creating a subsidiary company for exploitation of the product.

☐ Letting the inventor exploit the product, with the parent company holding a minority interest.

☐ Purchasing a company which has suitable production equipment or sales orientation.

The proper choice between these alternatives depends on the company's situation and policy, and will not be discussed further here.

The second possibility on our within-the-company list, and the first possibility on our outside-the-company list, are exploitation situations which occur frequently, and in both cases a party outside the innovation process must be convinced of the excellence of the product. Convincing an outsider is especially difficult for an independent inventor, who often lacks the financial facilities to carry out market research or an analysis of production costs. The situation is naturally the same when it is a matter of applying for a financial grant for the development of a product idea. It may therefore be appropriate to say a few words about the "myth of the inherent merit of an invention," which may be expressed as the belief that the merits of an invention can be seen at an early stage and that it will therefore receive the necessary support. This myth has been refuted by Davis and Banford in the following words: "Any product of work out of any research laboratory is unlikely to become successful without having the initiative and energetic support of a person or a group of people during various stages of its evolution". In other words, "An invention, with very few exceptions, does not have such obvious merit to all observers in its life history that it is hailed as an obvious contribution and will be accepted and implemented by all."

In practice, it is usually easy for specialists and examining authorities to classify an invention or product idea in an early stage of its development as technically and economically unrealistic, though the idea may later be developed into a profitable innovation. The reason for such mistakes is often found in a non-creative attitude in which it is difficult to foresee future technical development of the invention. Such a principally negative and non-creative attitude must however be regarded as typical when innovations are assessed at an early stage of development.

The motivation, not only of an inventor but also of a company or organization, is the expected profit. Therefore the more abstract an innovation is in fact, or is made out to be, the more uncertain is the situation when the economic risks or the expected profit are to be assessed. An innovation will consequently be accepted more easily if it is at what we will call a low "level of abstraction." (A low level of abstraction need not imply that the invention level is also "low," or not useful.) Here is an attempt to characterize innovations, in this case new products, by level of abstraction:

☐ Level 1: An *existing* product, but cheaper.

☐ Level 2: An existing product which performs better in some respect.

☐ Level 3: A *new* product which performs the same function as an existing product, but is cheaper or performs better in some respect.

☐ Level 4: A new product which satisfies another combination of functions than do existing products.

☐ Level 5: An *idea* for a product advantageous in ways that level 3 products are advantageous.

☐ Level 6: An idea for a product advantageous in ways that level 4 products are advantageous.

☐ Level 7: A product idea that in design or manufacture is based on a technical principle not previously applied in this way.

☐ Level 8: A product idea based on a new technical or scientific principle.

☐ Level 9: A product or process idea according to a physical or chemical effect not previously known.

The term "new product" means that the manufacturing method has been demonstrated in practice, and the term "product idea" that the manufacturing method has been demonstrated only in the laboratory.

Knowing that a high level of abstraction lowers the possibility of the product being accepted for exploitation, development work might be oriented towards products which have a low level of abstraction. This, however, is scarcely satisfactory in the long run, since there is a danger that economically attractive innovations will be lost in this way. For product ideas high in level of abstraction, the level can be lowered by technically demonstrating the production method, perhaps through the construction and operation of a pilot plant, which permits reliable assessment of larger scale production costs.

There has been too much emphasis on producing generators of information, and not enough on putting information to work.

The Basis of Our Civilization

It should be emphasized that the models proposed above to describe technical and economic progress through innovation activities are not to be regarded as reflecting a negative attitude toward scientific research, or taken as justification for such an attitude. The scientific method is still the basis of our civilization and, it is to be hoped, its future also. There is no actual reason so far to refute the idea that the results of research in the long run pave the way to material and cultural progress. With the specific intention of achieving industrial and economic growth, however, natural scientific and technical research should be supplemented by need-stimulated innovation activity.

The proposed innovation process is certainly not new or original. On the contrary, it might be seen as an attempt to systematize previously tested successful innovation methods into a complete procedure. (Bedrosian, in *Innovation* no. 22, has reported successful use of more or less the same process.) The characteristics of the process may be summarized as follows:

☐ The starting point is an identification and a specification of a need or demand. After a period of idea generation, selected projects are developed until an abstraction level low enough for demonstration is reached.

☐ Creative staff shall be used at least during the first three stages of the innovation process shown in boxes 1-3 of the illustration on page 20. Management should preferably also have some creativity.

☐ Free information flow as well as professional contacts with external and internal knowledge generators should be promoted.

☐ It is important that indicated decision points between the stages of the innovation process are observed. Three major criteria for project continuation should be checked at these points: agreement with need specification, whether the project constitutes technical development, whether it is possible to estimate a reasonable return on investment.

We have said that there are differences in motivation, working procedure, staff requirements and results between research, defined as seeking new knowledge by scientific methods, and innovation, defined as creating, developing and marketing new industrial products and processes. In practice there are no reasons for conflict between these concepts, as research provides the fundamental knowledge for innovation, and scientific methods are often used during the development stage of the innovation process. We think, however, that the Science Council of Canada has made a very good point, when it observes that "there has been an over-emphasis on producing *generators* of information, and not enough stress on putting existing information to work." Further study of the innovation process should prove highly fruitful.

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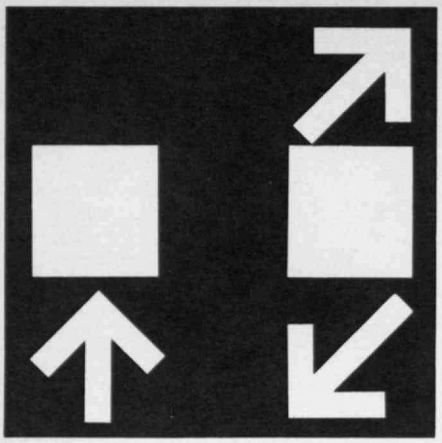

The Technical Supervisor: Beyond The Peter Principle

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When Peter and Hull proclaimed the Peter Principle—that in a hierarchy every employee tends to rise to his level of incompetence—they struck a responsive chord with the public. Their little book stayed on the best seller list for several months, although it offered little that was not already well known to readers of introductory books on organization theory. The Peter Principle is simply a provocative restatement of the logical fallacy inherent in a policy of promotion based solely on high past performance: the competence required for the new job may not be the same as that required for the old. Under such a policy, a person would be promoted until he reaches a position in which his performance does not merit further promotion.

The Peter Principle assumes that promotion is based on past performance. In addition, it implies that many people who have been promoted perform incompetently in their new positions, and that supervisory competence is a major influence on the performance of those who work under and report to the supervisor. Some research which I have been conducting on supervision of technical work provides a convenient basis for empirical tests of these assumptions. In this article I will present the results of these tests. Then, moving beyond the Peter Principle, I will discuss two factors I have found which distinguish effective technical supervisors, and identify four styles of technical supervision. I shall close by suggesting three tasks for the technical supervisor.

The research on supervision is based on a series of studies of productive climates for research and development which my colleagues and I have been conducting for the past decade at the University of Michigan and M.I.T. In all, over 2,000 scientists and engineers from fourteen industrial, government, and university organizations have participated. Although the research on technical supervision is limited to research and development settings, my experience with other organizations employing professionals (e.g., banks, schools, and hospitals) leads me to believe that many of the findings apply more generally to the supervision of professional personnel.

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Performance and Promotion

The Peter Principle assumes that good performance on the present job is the sole basis for promotion to the next highest organizational level. How true is this assumption?

The findings show that this assumption is true, but only partially. In a study of three development laboratories of a large electronics firm, I checked to see whether the past performance of an engineer was related to his currently being a supervisor. Results showed that many supervisors had been among the highest "performers" in the past, but the highest performers did not always become supervisors. And the sense of the word "performers" influenced the truth of the assumption. The performance measure most strongly related to becoming a supervisor was obtained by asking senior people in each laboratory to rank the engineers on "overall usefulness in helping the organization carry out its responsibilities." The assumption was less valid when I examined three performance measures more closely related to the technical work itself: a rating of "contribution to general technical or scientific knowledge in their field," the number of patents or patent applications produced, and the number of technical reports or formal talks which had been prepared.

Though past "performance" in all these senses of the word did predict that an engineer would become a supervisor, the relationships were so low that the company must have considered other factors in its promotion decisions as well. This finding is especially damaging to the basic assumption of the Peter Principle, since this company stressed an explicit policy that "performance pays off." My study of the company indicated that performance did indeed pay off, but it was just as likely to be followed by higher salaries and greater access to resources for technical work as by supervisory responsibility.

Supervisory Competence

The Peter Principle asserts that people rise in an organization to their level of incompetence. Just how incompetent are technical supervisors?

I investigated this question in two ways in a study of a division of a N.A.S.A. research center. Participants were over one hundred scientists and engineers doing research and development work rang-

The theory that technical personnel are promoted until they prove incompetent did not hold for technical supervisors. Their competence is a complex matter.

ing from basic research on chemical and physical processes to experimental research involving rockets and satellites.

First, I compared performance rankings of the technical supervisors with those of the other professionals in the division. If the technical supervisors had attained their levels of incompetence, they should have been among the lower performers in the laboratory. As in the study of the electronics company, senior managers were asked to rank order the performance of the professionals whose work they knew. An average of 7.6 senior people judged the performance of each professional. Three qualities of performance were used in this study: overall usefulness to the organization, innovation through increasing knowledge in useful and new lines of research or development, and productiveness through increasing knowledge along established lines of research or development. The rankings were converted to percentile scores so that the average person received a score of fifty on each quality of performance.

Supervisors were among the better performers on each quality. On usefulness the average supervisor was at the seventy-seventh percentile; on innovation he was at the seventy-second; on productiveness, at the seventy-first.

The skeptical reader may argue that these findings are not at all surprising. It is natural for senior managers to rate highly the performance of people they themselves may have chosen to be supervisors. The nonsupervisory professionals are a better source of information on the competence of their supervisors.

Anticipating such an objection, I asked everyone in the division who participated in the study to name people who were helpful to them in their technical work. They could name anyone at all, supervisor or nonsupervisor, inside or outside the division. Seven functions or "colleague roles" were specified for which people could be cited: locating technical information, help in thinking through a technical problem, critical evaluation, original ideas, providing a fair hearing for your own ideas, administrative help, and providing information about new developments in the division.

The supervisors were seen as helpful. The average supervisor was named far more often for each role than the average nonsupervisor. As expected, supervisors were named most often for roles associated with their positions in the formal organization: providing a fair hearing for ideas, administrative help, and providing information about new developments in the division. However, supervisors were also named very often for technical roles, for which any competent supervisor or nonsupervisor could be helpful.

The supervisors in this N.A.S.A. division clearly had not yet risen to their level of incompetence. Senior people ranked them among the best performers, and all participants in the study found them helpful for playing both administrative and technical colleague roles.

Supervisory Skills and Subordinate Innovation

The Peter Principle treats competence as a global phenomenon, discounting the possibility that people may be very competent in some areas and not so competent in others. A technical supervisor, for example, may be very good technically, inexperienced with human relations problems, and an incompetent administrator. In selecting a technical supervisor from a group of candidates, which skills should be emphasized? Is it better to select someone high in technical skills and moderate in human relations skills or someone moderate in technical skills but very good at human relations?

In an earlier study of the same N.A.S.A. laboratory just mentioned above, Frank Andrews and I investigated this question. We asked the professionals to rate their supervisors in each skill area:

☐ Technical—"He has a good understanding of the body of knowledge that is relevant to my work,"

☐ Human relations—"He is effective for providing appreciation and encouragement," and

☐ Administrative—"He is effective at carrying out needed planning and scheduling."

Then we asked N.A.S.A.'s senior scientists to judge innovative performance by the professionals.

How did supervisors' skills relate to their groups' innovation? We found a positive correlation between technical skills of the supervisor and innovative performance by the group reporting to him. Supervisors rated highest in technical skills by their subordinates had subordinates rated highest in innovation by the panel of senior scientists. Supervisors rated moderate in human relations skills had teams judged to be the most innovative. Finally, the supervisor's administrative skills were related *negatively* to innovation. Supervisors rated highest in administrative skills by their groups had groups judged to be the *least* innovative.

Thus, it is misleading to think of supervisors are simply competent or incompetent. For innovation by technical groups, the technical competence of their supervisors appears

Colleague role	Average number per supervisor	Average number per nonsupervisor	Per cent of all citations to supervisor
Technical information	5.2	1.5	42
Help in thinking	5.4	1.2	48
Critical evaluation	5.4	0.9	55
Original ideas	3.1	0.9	42
Fair hearing	4.1	0.3	72
Administrative help	5.7	0.4	76
Division developments	6.8	1.0	59

At a N.A.S.A. research center, personnel were asked to name others—supervisors or nonsupervisors, inside or outside their own divisions—who had been helpful to them in any of seven different ways, called "colleague roles." Supervisors were often cited as helpful in roles that one would expect of them as administrators. But they also proved helpful in technical roles.

to be especially important. And technical skills are typically considered very strongly in promoting men to supervisory positions. A technical supervisor chosen on the basis of his demonstrated technical competence would be unlikely to reach his level of incompetence when he becomes a technical supervisor.

Why did we find a maximal relationship between human relations skills and innovation when those skills were moderate? Perhaps those skills are more important for aspects of the supervisor's job other than stimulating innovation—for example encouraging people to persist at the more routine jobs which must be done in a scientific laboratory.

Why was administrative competence negatively related to innovation? Perhaps too much planning and scheduling interferes with the innovative process. Alternatively, perhaps something in the innovative process makes it impossible for a supervisor to demonstrate his administrative skills. At any rate, low administrative competence in the technical supervisor does not appear to pose great problems for organizations which stress innovation.

Beyond the Peter Priniciple

Competent performance is only one basis for promotion, and rewards other than promotion are offered for competent performance. Technical supervisors are among the most competent professionals in a laboratory, in the eyes of both senior scientists and bench scientists. And finally, supervisory competence is too global a term. When it is divided into technical, human relations, and administrative components, these components may relate positively, nonlinearly or negatively to subordinate performance. Thus the Peter Principle fails at this level.

Perhaps professionals who become technical supervisors would rise to their levels of incompetence if they were promoted one or two levels higher in the organization, where technical skills would be apt to be less important and administrative skills were more important. Unfortunately, research information is not available on the basis for promotion to middle management, the competences of middle managers, and the relation of middle manager competence to subordinate performance. Until it is, the Peter Principle will stand, as a delightfully phrased collection of part-truths. Technical supervisors—but not, as yet, their bosses—may breathe a sigh of relief.

But they shouldn't breathe too deeply. Some technical supervisors consistently do better than others. The professionals reporting to them score higher on rankings of usefulness to the organization, innovation, and productiveness. The bulk of our research on technical supervision has been aimed at determining factors which characterize the practices of these more effective supervisors. Two important factors have emerged, which appear to be related to the leadership style of the technical supervisor.

Time Pressure

The folklore about managing professionals includes two contradictory notions about time pressure:

☐ An unhurried "academic" environment facilitates performance.

☐ Tight schedules and deadlines facilitate performance.

The second notion is consistent with Parkinson's law that work expands to meet the time available.

Frank Andrews and I tested these notions in the N.A.S.A. laboratory. We asked the professionals to tell us by answering the following question—how much time pressure they experienced: "Technical jobs sometimes involve working under time pressure exerted by other people—results are needed urgently, there are deadlines to be met, etc. In a typical month about what proportion of your time is spent working

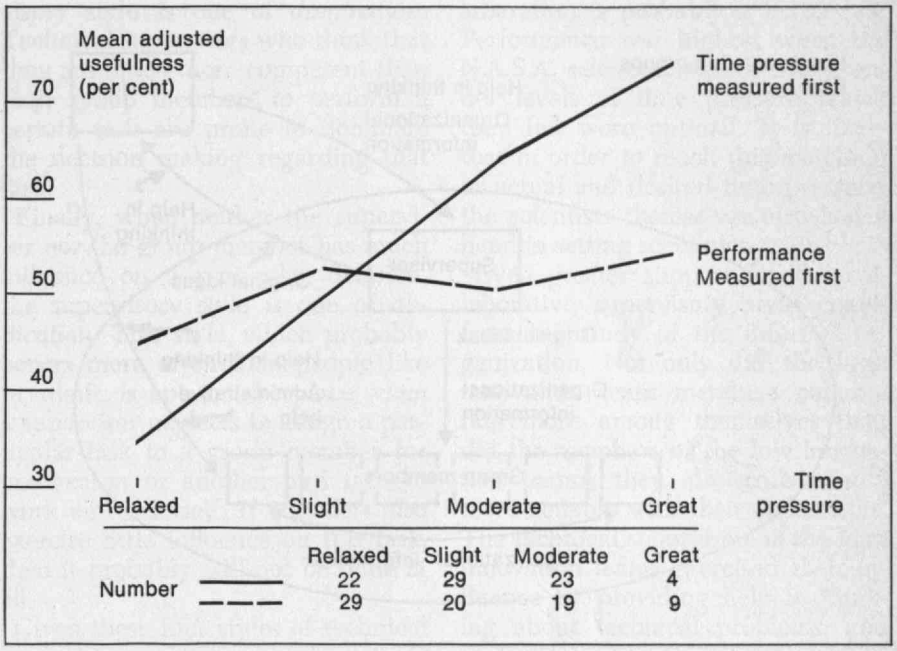
Interactions among researchers can be described by an "informal organization," in which there appear to be patterns that distinguish innovative groups.

under the following amounts of pressure?" Five categories of pressure were listed, from "Relaxed—no pressure at all" to "Extreme pressure—I'm behind on important deadlines." We repeated our measurements so that we could determine whether greater time pressure was followed by higher or lower performance, and whether higher performance was followed by greater or lesser time pressure.

We found that those professionals working under greater time pressure at time 1 were the higher performers at time 2. Higher performance at time 1 was not followed by greater time pressure at time 2. Virtually no one spent most of his time under extreme pressure.

In a second analysis we compared the amount of time pressure received with the amount the professionals said would be optimal. Highest performance occurred when the actual time pressure matched the amount of time pressure desired. Under conditions of too much or too little time pressure, performance was lower.

What role did the technical supervisor play in generating time pressure? The findings indicate that he was an important source. The professionals who reported working under more time pressure also reported that their supervisors exercised more influence on their work goals and provided them with less freedom to work on their own.



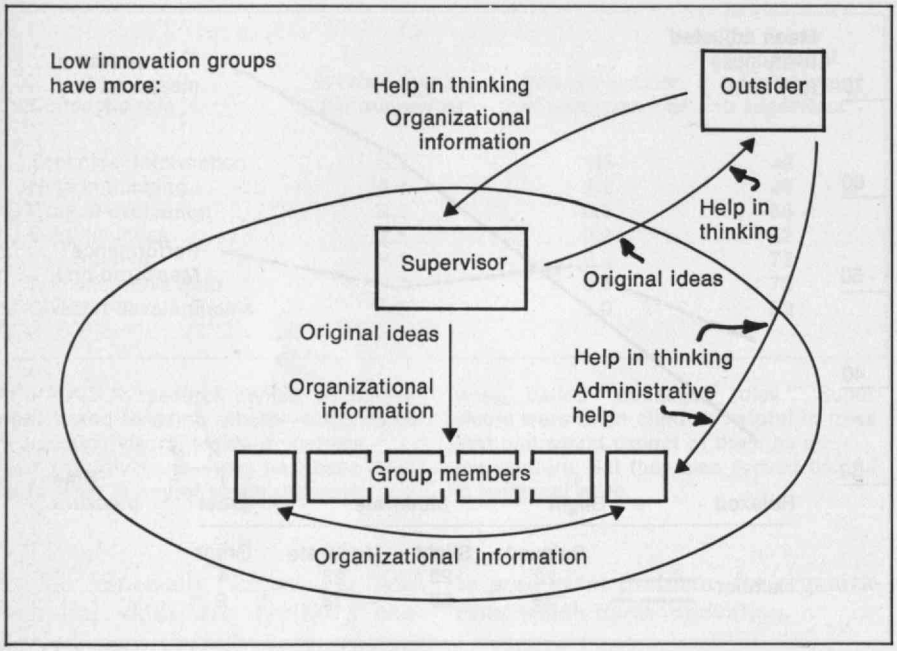
Personnel in the N.A.S.A. lab were asked to judge the amount of time pressure under which they usually worked. They could choose among five adjectives ranging from "relaxed" to "extreme," but almost no one chose that last. Their senior management was asked to rank-order the performance of the professionals whose work they knew. The broken line displays the data found when time pressure was measured after performance. The solid line shows the results of measuring performance after time pressure; apparently, greater (but not "extreme") time pressure led to greater performance.

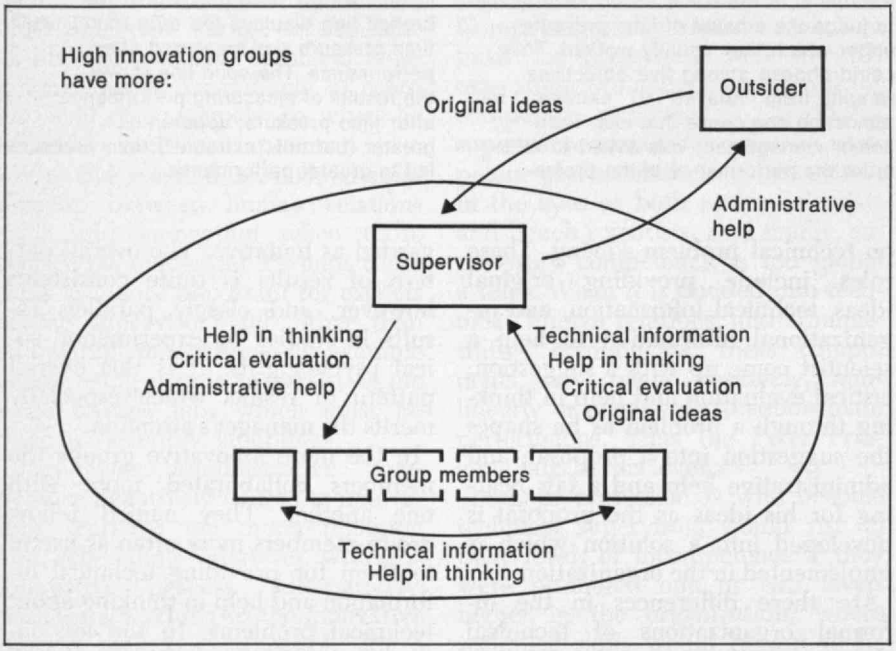
The Informal Organization

A consistent theme in our findings is the importance of the professional's interaction with his colleagues in solving technical problems. This interaction can be described as an informal organization in which scientists perform several roles for one another when they collaborate on technical problem solving. These roles include providing original ideas, technical information, and organizational information to help a scientist come up with a suggestion; critical evaluation and help in thinking through a problem as he shapes the suggestion into a proposal; and administrative help and a fair hearing for his ideas as the proposal is developed into a solution which is implemented in the organization.

Are there differences in the informal organizations of technical personnel? Because only fourteen groups participated in the study of the N.A.S.A. laboratory, specific aspects of the findings should be regarded as tentative. The overall pattern of results is quite consistent, however, and closely parallels results in studies by experimental social psychologists. It is this overall pattern of results which especially merits the manager's attention.

In the more innovative groups the members collaborated more with one another. They named fellow group members more often as useful to them for providing technical information and help in thinking about technical problems. In the less innovative groups, on the other hand, members named one another less often as helpful, except for one colleague role: providing information





The "flow" of colleague roles is contrasted for groups found to be highly innovative and groups that are not very innovative. There was more internal collaboration in the former. Members of the latter often found persons outside their own groups helpful.

about developments elsewhere in their organization.

Consistent with these internal differences in the informal organizations of high and low innovation groups, the more cohesive high-innovation groups received relatively little help from professionals outside their groups. On the other hand, members of the low-innovation teams found outsiders especially useful for help in thinking about technical problems and administrative help.

Moreover, there were differences in supervisory behavior between the high and low innovation groups. In the high innovation groups the supervisors were more active participants in the informal organization. They were especially helpful to group members for critical evaluation, administrative aid and help in thinking about technical problems. In addition, group members were more helpful to these supervisors for providing technical information, aid in thinking about technical problems, critical evaluation, and original ideas.

In the low innovation groups the supervisors were much less active in the informal organization. They were named by their groups more often than supervisors of high innovation groups for only two roles: original ideas and organizational information. There were no roles at all for which members of the low innovation groups were more helpful to their supervisors than were their counterparts in high innovation groups to *their* supervisors.

As in the case of the group members, the supervisors of the low innovation groups collaborated more actively with outsiders than did the supervisors of the high innovation groups. Supervisors of low innova-

Technical supervisors can choose among four styles, from collaboration to abdication. Collaboration is best, but the others have their uses under special conditions.

tion groups were more useful to outsiders for original ideas and help in thinking, while outsiders were more useful to them for providing help in thinking and organizational information. Supervisors of the high innovation teams named more outsiders as helpful for only one role—providing original ideas, and outsiders named them more often only for administrative help.

In short, the high innovation groups operate more as teams, collaborating actively with one another in their technical problem solving. The supervisors of the high innovation teams participate fully in these collaborative efforts, playing technical as well as administrative roles.

Supervision: A Process of Influence

What do these findings about time pressure and the informal organization imply for supervisory behavior?

Let us consider the case of a supervisor and a member of his group. In making a particular decision, the supervisor may exercise relatively high or low influence himself, and through his behavior he may allow his subordinate to have relatively great or relatively little influence. Thus, four styles of supervision are possible.

When both the supervisor and group member have a great deal of influence in making a decision, the supervisory style is one of *collaboration.*

When the supervisor has relatively little influence on a decision but the group member has a great deal of influence, the supervisory style may be called *delegation.* Technical supervisors often delegate routine testing jobs to group members.

When the supervisor has a great deal of influence and the group member has very little, the supervisory style is one of *domination.* Technical supervisors who think that they are much more competent than their group members to perform a certain task are prone to dominate the decision making regarding that task.

Finally, when neither the supervisor nor the group member has much influence on a particular decision, the supervisory style is one of *abdication.* This style, which probably occurs more often than people like to admit, is apt to take place when a supervisor neglects to assign a particular task to a group member for one reason or another and fails to work on it himself. If outsiders also exercise little influence on this task, then it probably will not be done at all.

Given these four styles of technical supervision—collaboration, delegation, domination, and abdication—two questions follow. Is one of these supervisory styles better on the average? And, under what special conditions is each style most appropriate?

To answer the first question, let us recall the studies of time pressure and the informal organization. Time pressure facilitated higher scientific performance, and the technical supervisor was an important source of time pressure. Supervisory styles consistent with this finding are the two in which the supervisor exercises high influence: collaboration and domination. Supervisors who delegate or abdicate in the setting of schedules and deadlines are apt to have lower performing groups.

But, in the setting of schedules and deadlines is it better for the supervisor to collaborate with his group or to dominate these decisions himself? The second finding from the time pressure study indicates that collaboration is probably a better bet. Performance was highest when the N.A.S.A. scientists were working under levels of time pressure which they felt were optimal. It is likely that in order to reach this matching of actual and desired time pressure, the scientists themselves also had a hand in setting schedules.

Even greater support for the collaborative supervisory style comes from the study of the informal organization. Not only did the high innovation team members collaborate more among themselves than did the members of the low innovation teams; they also collaborated more actively with their supervisors. The technical supervisors in the high innovation teams exercised their influence by providing help in thinking about technical problems, and by critical evaluation of group members' ideas, as well as in making administrative resources available. In turn, supervisors benefited from the influence of group members, who provided technical information, original ideas, help in thinking about technical problems, and critical evaluation of the supervisors' ideas.

In the low innovation teams, the technical supervisors were using a style of domination for some colleague roles, and abdication for others. Supervisors were named by group members as helpful for providing original ideas more often than in high innovation teams, but were relatively uninfluenced by help from their subordinates. Instead, they turned to outsiders for help in thinking.

Members of the low innovation groups found themselves faced with highly original supervisors who had essentially abdicated any attempt at creating the kind of informal organization in which they could easily

Supervisors have three tasks: managing goal-setting, affecting professional interaction, and facilitating professional growth. Typically, managers neglect the last two.

collaborate among themselves. Thus, they were more apt to turn to outsiders for help in thinking about technical problems and administrative help and resources.

To sum up, the studies of time pressure and the informal organization indicate that a collaborative supervisory style is best if the criterion of success is the performance of group members. Domination may achieve results also, provided that the original ideas of the technical supervisor are worthwhile and that the deadlines he sets are realistic. However, in the groups in the N.A.S.A. laboratory, domination was accompanied by less collaboration among group members, less usefulness of group members to their supervisors, more reliance on outsiders for help by both group members and the supervisor, and lower innovation by group members themselves. When a supervisor delegated scheduling to his subordinates, they felt less time pressure and their performance was lower.

No evidence was found to support the notion that a supervisor should completely delegate the performance of colleague roles to his group members. In the high innovation teams, performance of colleague roles by team members was accompanied by technical help from the supervisor suggesting that collaboration, not delegation, was the predominant supervisory style. Although the supervisors of the low innovation teams may have thought that they were delegating the performance of colleague roles to their groups, the results indicate that they were in fact abdicating. Group members turned to outsiders for help.

Nothing in the research findings suggests that abdication is a good supervisory style to use. To the contrary, the findings suggest that performance is lowest when there is little time pressure—from supervisory or self-imposed deadlines—and little interaction with the supervisor in technical problem solving.

The Usefulness of Other Styles

The research findings thus suggest that on the average, a collaborative supervisory style is most likely to lead to higher performance by technical professionals. However, under certain conditions other supervisory styles may be more appropriate.

Are there time constraints which prohibit collaboration in making the decision? If time constraints are low, then any one of the four supervisory styles is a possibility. If time constraints are severe, then collaboration is ruled out, since a decision-making process involving influence by both supervisor and group members tends to be time-consuming. Delegation and domination take less time than collaboration, and abdication takes virtually no time at all.

Is the group member competent to help with the decision-making task or to perform it himself? If group member competence is high, then collaboration or delegation is possible. If group member competence is low, then domination by the supervisor or abdication may make more sense.

How important is it that the group member accept the decision which is made? Acceptance is more likely when the group member influences the decision-making process. If acceptance is important, then collaboration or delegation are appropriate supervisory styles to use. If acceptance is relatively unimportant, then domination or abdication is more appropriate.

How competent is the supervisor to perform the task himself? If supervisory competence is high, then collaboration and domination are possibilities. If supervisory competence is low, then delegation or abdication are more appropriate.

But abdication is appropriate only when time constraints are high, supervisory and group member competence are low, and group member acceptance is unimportant. If the decision-making task in the latter situation is important to the organization, then responsibility for it should be transferred to another group.

Is there research evidence which indicates that these are good decision rules for a technical supervisor to follow? The assumption behind the rule that severe time pressure rules out collaboration—that two people take longer than one to make a decision on the same issue—is quite consistent with common sense and everyday experience. It has been supported by studies of communication networks by experimental social psychologists.

The assumption that influence and competence go hand in hand is quite consistent with a finding in our study of the electronics firm. There, higher technical performance was associated with greater influence on work goals. In an experimental study of leadership, Francis Lim and I found that supervisors who were told that they had high performing groups gave members of their groups more influence in decision making. Finally, in a study of influence in a federal-state government system of development banks in Brazil, D. Anthony Butterfield and I found that the simplest explanation of differences in bank effectiveness was that in the more effective organizations more influence was given to those professional engineers,

lawyers, and economists who had the technical competence required to perform the tasks for which they were most responsible.

The assumption that a person is more likely to accept a decision when he has influence in making it is widely documented in psychological studies of participation, influence, and satisfaction.

The assumption that if a technical supervisor has the competence necessary to perform a task, it is appropriate for him to influence it—and that otherwise, he is better off if he provides freedom for his group members to work on their own—has direct support in the findings of Frank Andrews' and my study of supervisory skills and innovation. Overall, we found only a mild positive relation between provision of freedom by the technical supervisor and innovative performance by his group. However, we then examined the relationship between freedom and innovation separately for supervisors who were high and low on technical, human relations, and administrative skills. For supervisory competence in each skill area, we found the same thing: when a supervisor was highly skilled, providing freedom made little difference. Sometimes it helped, and sometimes it did not. However, when a supervisor was relatively low in any one of the three skill areas, group innovation was higher when he provided greater freedom. The moral for the technical supervisor is clear: If you don't know what you're doing, then stay out of the way!

Three Tasks for the Technical Supervisor

In this article I have concentrated on relationships between group member performance and time pressure in goal setting, and the interaction which occurs in the informal organization. I have also proposed four supervisory styles and suggested that on the average, a collaborative style, permitting considerable influence by both supervisor and group member, works the best. I have also suggested conditions under which each supervisory style is apt to be most appropriate and mentioned some research which supports these contingencies. But thus far I have been quite vague about the tasks and decisions for which each supervisory style may be used.

In my research, in informal conversations with scientists and engineers, and in visits to research and development organizations, I have found that it helps to think of the technical supervisor as having three kinds of tasks: managing goal-setting, affecting the interaction which occurs in the informal organization, and facilitating the professional growth of his group members. Conversations with technical people from a variety of organizations convince me that the task of managing goal setting is greatly emphasized, but the other two are not. Typically they come up only when problems are raised. For example, comments have been made to me such as "My supervisor —I haven't seen him for days," or "Performance appraisal—frankly I have no idea what my supervisor thinks of my future potential with the laboratory."

The predominant supervisory style in each of these instances is abdication. Typically the supervisors involved think that their style is delegation, that the group members who made such comments were free to influence their own interaction in the informal organization and their future careers with the laboratory. But the group members think that it is the supervisor, after all, who is responsible for seeking them out to discuss technical matters and for letting them know about future professional opportunities with the laboratory. The result of these misperceptions is low influence by both supervisors and group members on the nature of the informal organization and the professional growth of the technical personnel. These two tasks are apt to be critical for the long-run effectiveness of the laboratory. The remarkable success of so many Japanese technical organizations may be due in part to the informal organizations they create—through the "ringi" system of decision making and the assignment of previously acquainted professionals to projects—and the attention they can give to professional development because their professionals are hired for life.

Peter and Hull were right to focus on competence. However, the problem of technical supervision does not derive from anything as simple as people rising to their levels of incompetence. Rather it is one of identifying decisions to be made in all three task areas of technical supervision and distributing influence among those competent to make them, through collaboration, domination, or delegation. In an organization of professionals, just about everyone is competent to do something. As a result, it is too often assumed that he is doing it, and abdication becomes the supervisory style. A major challenge for the technical supervisor is to adopt supervisory styles which overcome a tendency to abdicate.

Suggested Readings

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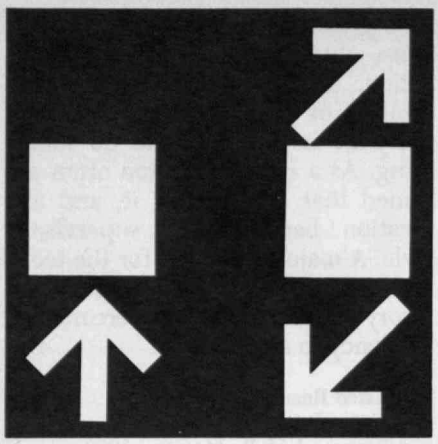

Venture Management and Capital

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How do I form a technologically-based company? Where do I get the money to start my version of The Great American Dream: applying technical know-how, owning and running my own organization, becoming rich in the process?

The desire is easier than the doing. Many such ambitions remain daydreams, never put into practice for many reasons, among them simply fear of the unknown.

Yet starting a new corporate venture, though not easy, can be straightforward. Enough organizations have germinated and grown to successful maturity that criteria and conditions have been developed which, while they will not *insure* success, will reduce risk.

A new business venture is by definition full of risk; "venture," according to Webster, includes risk, chance, or danger. The money invested in such enterprises during early high-risk stages is called venture capital. The key figures in a new venture company are the founder-manager—or entrepreneur—and the financier—or venture capitalist.

As the venture successfully develops and matures, investment risk will become subject to the rational criteria of security analysis. A visible performance or "track" record will develop, including such factors as sales volume, profits, net worth, return on assets, and earnings per share. With a corporate record in hand, the security analyst can apply conventional investment techniques with some degree of confidence. He can compare the company, which has demonstrated that it can pass through the early difficult stages of organization and growth, with others in its field.

But in the early stages of a venture company, there is no such record. All that exist are an idea, some people, and a plan. There is no history, no demonstrated performance, but only projections, often merely hopes. This is the niche in the spectrum of finance and investment which the venture capitalist fills. Part financier, part manager, part business doctor, and part psychologist, he provides an important partner for the entrepreneur throughout the early life of a company.

This article deals with the genesis of a new venture, a new or young company with growth aspirations which, in the future, hopes to issue securities to the public, to meet the tests of conventional security analysis. But for the present, the source of outside financing is venture capital.

The New Venture

Technology companies, the so-called knowledge industries, have historically been the principal consumers of venture capital. In fact, a large number of high-growth technology companies—Polaroid, Xerox, Digital Equipment—have been the glamorous high flyers in the investment community. From their successes has sprung much of the success of the now established venture capital industry.

In the 1950s and 1960s, the principal ingredient of a successful venture was a good technical idea for which government funding was often readily available. Many companies were formed on the basis of a government contract, so the need for general management expertise was subordinate to the need for technical skills and government contract know-how. Financial and investment risks were often minimal.

As we move into the new era of the 1970s, we find that many of these initially successful ventures of the '50s and '60s are no longer to be found. We find that dependence on government contracts may be the riskiest of all markets. A successful venture in the 1970s must be heavily oriented toward private markets. Management and financing techniques become quite different, though not necessarily more sophisticated.

This second generation of venture capitalism institutions is quite different from the classical era's venture operations. Some of the new financing organizations are financial institutions; others are operating companies which are moving into the business of financing other companies. Rather than losing people who in the past have left to form their own companies, these large businesses are "spinning off" their own people in various ways which include subsidizing and financing them, helping them to set up operations, or providing management to steer and assist them.

Venture Management

There is no single overriding factor in generating success for a new venture unless it is applying the general principles of good management. Many variables, such as research

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Now there are guideposts that can reduce the risk in starting a company based on new technology.

and development, marketing, selling, manufacturing, accounting, finance, and personnel have to be balanced in forming and running a new organization. It is important that entrepreneurs recognize that the job of management is to synchronize them all. The key to all this is Management Planning—the careful and deliberate pulling together of all aspects which go to make up a successful corporate organization. These include specific and integrated marketing, manufacturing, distribution, organization, and financial plans.

Of the three necessary elements in starting a venture—technology, management, and capital—management attracts, organizes, and develops the other two: good management finds and recognizes technology, and capital comes to good management.

Management has been defined as the art of getting things done through other people, so of foremost importance in starting a new company is starting with the right people. These right people must have marketing awareness—simply, What product or service will the new company produce?—When will it be produced?—Who will buy it?—How much will they buy as a function of time?

A corollary to marketing awareness is planning for a product line, since a company founded on a single widget, with no follow-on products or extrapolations, is doomed to a short life —through product obsolescence, if not through competition. A company should have a long term concept of what it is in business to do. The most successful companies do this by being "market-oriented" rather than "product-oriented." They see a need, or a market, which they seek to serve. Merely having a better product or a better technique for doing something does not insure corporate success. The ability to perceive the consumers' needs, to apply technology to fill these needs, to distribute and sell the resulting product or services, are essential ingredients for corporate health and growth.

The executive role in which the founders find themselves can be interesting, challenging, and, at times, frightening. They have cast off old associations. Services available in their previous company or institution, which they took for granted, are suddenly direct concerns and immediate problems. The founders will find themselves spending a great deal of time with a new group of associates—directors, lawyers, public accounting firms, commercial bankers, investment bankers, public relation firms, press, as well as venture capitalists. The new officers will find that these outside contacts take more time than they had ever imagined and that the trust and goodwill of these contacts are important to the success of the company.

The Importance of a Plan

To properly apportion its limited resources, it is of paramount importance that any new company have a plan. It can be changed with time, but it should be kept up to date. The plan indicates simply what the company plans to do, who will do it, when it will be done, and how much it will cost. It should be a record of thought and conclusions, of the planning process itself. But it is imporant as a document because it can be distributed; it can serve as communication, both within the company and to the outside world—especially to venture investors, who are not likely to waste their time on a company lacking the foresight or ability to make a meaningful presentation of its proposed activities.

There are as many ways to put together a plan as there are companies or financial institutions. Experience shows that a plan serving the purpose of both the company and potential investors should include the following items:

☐ *A description of the business,* including the history and nature of the company and its product or service. The reasons for the creation of the company and for entering a specific market should be included. A background of the industry and its growth provides a reference for future projections and their justifications.

☐ *A market survey* that identifies customers, the size of potential demand, and competition. It provides data pertinent to the setting of pricing schedules and suggests ways to tell the company's story and bring the product to the customer. Current market size, conditions, trends, and competitive shares of the market are necessary ingredients, as are comparisons of the company's product or services with those of other major competitors. Problems, negative factors, and hazards in the entire industry or facing the company should be viewed frankly and completely.

☐ *A development plan,* spelling out research and development programs and requirements and including schedules for each phase of development, and its cost.

☐ *A manufacturing plan* that includes the processes used for manufacture and details on manufacturing facilities: their location; size; cost of buying, renting, or building; together with equipment needs and their cost.

☐ *A distribution and service plan*

dealing with the steps necessary to bring the product into the market place, including the cost—in advertising and selling—of bringing the product to the customers, estimated market penetration and timing, together with pricing strategy, sales, and service policies.

☐ *Management organization.* The exact duties and functions of each of the key personnel should be described, including resumes of each person's background and the dates on which each will join the company.

☐ *Financial projections,* including earnings and cash flow, should be completed for at least three years; longer, if market penetration will take longer. Assumptions should be clearly indicated. The cash-flow statement is extremely important since it reflects the estimates and projections of the amount of financing needed and when it will be needed, and the generation of income as the company matures.

☐ *Financing requirements.* Here the precise financial needs of the company are presented; exact dollar amounts and the dates on which they must be made available; and a schedule for the use of funds when they are made available. Also included should be the terms of proposed financing, including the financial instrument, number of shares, and price of shares. This section is, in brief, a summary of the financial strategy of the company.

The word realism should be emphasized. Not only should the plan be realistic, the entrepreneurs should also make plans, using more conservative projections. In fact, prospective investors often ask to see pessimistic projections.

In forming a new company, entrepreneurs tend to be optimistic, eager, and enthusiastic. Unfortunately, this optimism shows in their planning, so that the accumulation of errors invariably occurs on the optimistic side. Events seldom come out better than the entrepreneurs predicted; they almost always come out worse. Therefore, the new company should prepare a "worse case plan" which shows what happens if the market and the economy holds up but their own corporate efforts do not bear fruit as fast as they had anticipated. In addition, it is often wise to prepare a "worst case plan" which assumes not only that the company is not growing as fast as the original schedule but that the market and the economy are worse than anticipated.

These worse case plans provide a vision of disaster which forces the entrepreneurs to face the full spectrum of vagaries in their business and the economy. In many cases it makes them see risks that they had not seen before. In some cases it causes them to decide not to take these risks, and they never launch the newly-planned venture. But it is better to find out these facts before embarking on a new enterprise.

Venture Capital

Until a few years ago venture capital was considered something of a black art with a certain mystique. And venture capitalists were the last of the Mississippi riverboat gamblers. But particularly in recent years, venture capital investment has become more of a science, with well-established institutions and organizational approaches.

More than an ample supply of venture capital is available for small businesses and new enterprises. In fact, many billions of dollars await talented people with good business ideas, but the exact whereabouts of the sources are often difficult to uncover, particularly for the uninitiated. Venture capital may be found from investment bankers, mutual funds, individuals, family trusts, insurance companies, pension funds, commercial banks, corporations, private and public venture capital companies, small business investment companies, and private partnerships. Venture capital funds and private partnerships were often organized expressly for this purpose.

The objectives, motives, and methods of venture capital organizations vary considerably from one to the other. Some are interested primarily in frontier research, others are interested in high technology that has marketability now or in the immediate future, still others are strong in different areas, such as marketing, and tend to stay away from high technology.

A venture capital investor seeks high-risk situations. And since the risks are high, the potential returns on such investments are also expected to be high: the risk/reward ratio may vary from a desired return on investment of five to twenty times. As a reasonable rule of thumb, a venture capitalist expects a three-fold return on his investment in four years, or four-fold in five years.

A young company or start-up enterprise should generally offer the following to be attractive to a venture capitalist:

☐ A product or service with a large market potential.

☐ Patent protection of skill and know-how, or assurance that no one else has a patent.

☐ An experienced, talented management team.

☐ A company which, when successful, can and wants to go public.

☐ An industry likely to be above-average in price-earnings ratio if publicly owned.

Because of the sophistication of the venture capital community, new ventures sponsored by venture capital organizations do not fail as often as small businesses in general (which die at a rate of about 180 a day). This is due primarily to the careful filtering that takes place before a new company is financed by a venture capital company. On the average, 95 to 97 per cent of initial proposals submitted to a well-established venture capital firm are rejected out of hand. About 3 to 5 per cent get a second reading. Approximately one per cent get a close look and about ½ of one per cent are financed.

But the better-than-average success rate reflects not only fine screening, but the management relationship that good venture capital firms provide with their clients during the growth of their company. Many successful venture capitalists estimate that 90 per cent of their effort with a new company is not expended until after the initial financing of the company. In fact, one definition of a true venture capitalist is one who provides management assistance and hand-holding in addition to money.

In approaching the venture capitalist, high-powered salesmanship should be left at the door. So should any tendency to agree to do whatever it takes to get the money. Experienced venture capitalists have seen thousands of proposals, and can quickly sort out the sound concept from the over-zealous sales pitch. Complete, open, and thorough information on the intention and plans of the new venture should be presented to the venture capitalist to help him make the best investment decision.

Shopping around is, in general, dis-

The first generation of venture companies relied heavily on the government market; the new generation cannot.

couraged, and quickly wears out a proposal. However, not all venture capitalists are interested in the same industries or business area. The entrepreneur should not become discouraged if he is turned down by the first one or two venture capitalists. He should expose his proposal to a selected few with different interests. It may be that the business area proposed is not one in which a given venture firm has experience or feels comfortable.

A proposed venture should be exposed to a small number of venture capital sources initially for several reasons:

☐ If the venture is attractive to the investment community, investors may prefer that financing be consummated by more than one group.

☐ The venture may need specific types of assistance from investors which may be available only from different sources.

☐ Reactions from more than one investment group are desirable to determine attractiveness of the venture, as well as to determine what kinds of assistance are available.

☐ The entrepreneurs should be seeking the best financing terms available.

How Much Money?

Some entrepreneurs seem to think that the more financing they can generate, the more successful they have been. Others think that the less they raise, the more successful they have been. Both are wrong. The entrepreneur who raises more money than he needs is selling off more ownership in his company than is necessary. The entrepreneur who raises insufficient funds is in a potentially precarious situation since he may have underestimated or understated his requirements and may then have to return, hat in hand, to the financial community at a critical stage of corporate growth.

The answer to the question, "How much money should I ask for?" is simply "How much does the company need"? But the entrepreneur should remember that financial need usually follows a smooth curve while capital injections come in a series of steps.

Financing for a new company is obtained by renting, leasing, or buying funds. A loan or short-term note is *rented* by paying interest. Money is *leased* through debentures or bonds with a relatively longer fixed paid-back period. Money is *bought* through stock offerings. Intermediate combinations include convertible debentures and warrants which provide options to buy equity.

The relationship of debt to ownership should be clearly understood by the entrepreneur. In many cases he need not obtain full initial or intermediate financing by selling stock ownership in the company, but can obtain financing through loans from such institutions as a bank or the Small Business Administration.

Entrepreneurs always wonder what per cent of the company should be sold for how much capital? They usually wish to sell off as little equity in the company as possible. This is a noble objective, but it must be continually weighed against the actual value of the entrepreneur's portion of the company. If an injection of capital can make his own holding increase in value over a period of time, even though he owns a reduced percentage of his company, selling some ownership might be a good idea.

Ownership is frequently mistaken for control. Control can be exercised in many ways. If a creditor holds a note which is overdue, he may, in fact, control the company by his decision whether or not to foreclose. But depending on the sort of financing, this creditor may own none of the company.

What the Investor Wants to Know

An experienced venture investor seeks answers to ten basic questions when evaluating a new technology company:

☐ *Is the company in an area of emerging technology*? Does the technology have a solid base for growth as measured by the research and development efforts that can be put into the technology by the venture, and are put into it by other companies? If the technology is way ahead, is it too far ahead? Where is everyone else? Why? Do I, the venture investor, understand the technology and its potential growth? If it can't be explained to me, whatever my background, I'm suspicious, for if it can't be explained to me, how can it be explained to the customer, the directors, and other investors?

☐ *Is there a market for the technology or product*? Basically, is there a need already demonstrated? Or will it create a new market?—new-market speculation entails the highest risks but the greatest rewards. Does management understand the market and how to exploit it? What's the competition?

☐ *Why didn't an established company decide to exploit and market the product*? The entrepreneur may tell me his old company didn't understand him, stifled his inventiveness. This can often be tue. It may also be true that the parent company made a market evaluation and determined that the product was not worth exploiting further. On the other hand, maybe the parent com-

pany thought it was a good idea but just couldn t invest resources in it.

☐ *Is there a natural product line or follow-on technology*? Has the new concept or product or technology a long-range career and reproductive aspects? Is the management flexible and adaptable to change?

☐ *Does management have corporate experience*? The key people, particularly the decision-makers, should have experience either as officers or as directors of a profit-making corporation in a technology area. Though there are always exceptions to the rule, the chief officials probably should have been around the corporate track so they know what to expect and how to plan.

☐ *What are management's goals*? Only to make money? This type of leadership will go over the side quickly—its goals may be in conflict with corporate and stockholder goals. The best entrepreneurs are those who like to run things, organize them and grow them.

☐ *Does management have a ten-year objective and a five-year operating plan*? These may change with time, but they should always be clearly stated at the outset.

☐ *Does management understand and have capabilities for all phases of its operations, from research through production and marketing, as well as support functions—comptroller, accounting, legal, and so forth*? The missing manager, whom the company is going to hire tomorrow, can always be the weak link in the chain. The full span of experience and authority should be visible at the outset.

☐ *Does management understand the nature and use of money*?—extremely important, regardless of how good the ideas or the management is.

☐ *Does management have a competent, recognized leader and decision-maker*? Group decision-making may be fine in the textbooks, but it doesn't work very well in a small emerging organization that has to make decisions fast if it is to survive.

After these questions, the remaining fundamental judgement for the venture capitalist is whether or not he feels comfortable. In a new company, the investor is primarily judging people. If his own intuition or gut reaction makes him feel uncomfortable, he should and probably will stay away from the company.

Investor and Entrepreneur

A true venture capitalist, while understanding the financial risks, wants to help the company grow. He will have a continuing personal interest in the company, and the nature of his interest will change with the growth of the company. His outlook will be positive; he will ask what he can do to make the company and his investment grow, rather than try to predict all the ways the company could fail and devise a way to protect his investment in each case.

The entrepreneur should remember that the venture capitalist has as much at stake as he—perhaps more. If a company fails, the entrepreneur can usually get a good job elsewhere. But the venture capitalist cannot readily walk away from a financial disaster. He must endure damage to both his investment resources and his professional reputation, for financing ventures is his career. In fact, while the entrepreneur usually assumes he is taking all the risks and the venture capitalist is only supplying the money, the venture capitalist thinks that he is, in fact, taking more actual risk than the entrepreneur. In any case, the venture capitalist works under the same compelling forces as the entrepreneur.

If the venture capitalist tries to tie up the company with too many financial gimmicks or penalty clauses, the entrepreneur should have second thoughts about dealing with him. The situation of a new company failing won't be helped by extra penalty clauses. They will only put more pressure on the entrepreneurs. There are many sources of venture capital, and it is most important for the new venture to find one which is compatible with its corporate objectives, personalities, and long-range strategy.

Planning Early

Unless the entrepreneurs understand the management and financing of corporations, they cannot expect to negotiate the best financial arrangements from a venture capitalist. In fact, unless they show a great deal of sophistication in these matters, the venture capitalist will question whether they have the know-how to manage a company. While the venture capitalist is in a position to help a new company after it has been formed and financed, he rarely has the time or resources to help would-be entrepreneurs put together organizations and plans.

Venture capital firms are moving more and more toward investing large sums of money with less risk in companies which have already begun to establish a track record. Thus a gap is emerging between the entrepreneurs of a would-be company and the financiers of that company. As we move into second generation entrepreneurship, in the wake of the first generation in the '50s, that relied in general upon government contracts, this gap is beginning to be filled by management and development groups. These are organizations which provide management help to form companies.

Wherever they obtain their information, the entrepreneural team should become educated and seek assistance in management and finance of high-growth companies before launching their new venture. After the company is launched it's too late. The energies of all those on board will be directed toward the day-to-day problems they had planned on, and many more that they had not foreseen.

Solo Flight

Launching a new company is, in many ways, like learning to fly. Instruction and planning on the ground beforehand is vital. Dual instruction is an obvious requirement before soloing, and a qualified copilot is always welcome in stormy weather.

In the early days of both flying and venture technology companies, only a special breed, practically a daredevil, would attempt it. As both areas have matured and experience has grown, we know now that a broader spectrum of men of different aptitudes and backgrounds can succeed—men who are eager to learn techniques and skills which can be acquired. The art and mystique of entrepreneurship, like flying, has been increasingly supplanted by the scientific approach.

Seat-of-the-pants venturing is obsolete; the motivated individual has available roadmaps and guideposts which can multiply his chances of success. But he has to find them first and become familiar with them before trying his entrepreneural wings. It is then that a new venture company can become interesting, exciting, and rewarding.

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Technological Foresight for Congress

Having voted itself an Office of Technology Assessment, Congress not only is in a better position to play its constitutional adversary role but also can openly, thoughtfully, and more effectively influence the directions of technology.

During the great congressional debates in 1970 and 1971 over the supersonic transport, both sides cited the most dramatic arguments they could find to buttress their cases. Proponents claimed that an American S.S.T. would eventually improve our balance of trade by $30 billion and generate indirect employment for hundreds of thousands. Opponents warned of a chamber of environmental horrors: sonic booms during flight which would be unacceptably startling and damaging, intolerable noise on take off and landing, exhaust emissions that could disturb the delicate chemistry of the stratosphere and allow dangerous ultraviolet radiation to pass through. Some of these technical arguments had real merit. But by the time the debate reached its climax they served more as battle cries to rally public opinion than as issues to be responsibly considered in reaching a rational decision.

In recent years, Congress has increasingly been required to make decisions about unfamiliar new technologies—in the last session alone the list included the S.S.T., nuclear power development, pesticide regulation, and military weapons systems. Sound judgment on such matters obviously requires an understanding of the more likely consequences of the development of these technologies, of the costs and risks as well as the benefits. Yet almost never—certainly not during the recent S.S.T. debates—have Congress and the public been given an authoritative assessment of the costs and benefits. Instead, the Executive branch agencies present Congress with a sales pitch, and expert witnesses contradict each other in hearings. As Representative Charles Mosher (Ohio), ranking Republican on the House Science and Astronautics Committee, has commented in floor debate:

"Let us face it, Mr. Chairman, we in the Congress are constantly outmanned and outgunned by the expertise of the Executive agencies. We desperately need a stronger source of professional advice and information more immediately and entirely responsible to us and responsive to the demands of our own committees."

Mr. Mosher's remarks were in support of legislation to establish a congressional Office of Technology Assessment (O.T.A.). This legislation passed both Houses in the closing weeks of the 92nd Congress and was signed into law on October 13, 1972. Although the scientific and engineering communities paid little heed to the bill's enactment, the O.T.A. can potentially have a significant impact, not only upon the senators and representatives it is designed to serve, but also upon the course of technological development in the United States.

The first Chairman of the Technology Assessment Board, which controls the O.T.A., is the dynamic and highly visible Senator Edward M. Kennedy (D-Mass.). Especially in view of President Nixon's dissolution of the White House science and technology advisory apparatus in January, Senator Kennedy and the O.T.A. are in a good position to assume national leadership in technological planning.

Necessity of Technological Choice

Federal technological projects such as the supersonic transport, the breeder reactor, and military weapons systems are developed in Executive branch agencies and then sent to Congress for authorization and appropriation. Congress is rarely presented with an explanation of the alternative programs considered and why these were rejected in favor of the proposal ultimately selected. Nor are such programs accompanied by background papers stating the important technical considerations, evaluating the benefits and costs, and identifying risks arising from lack of technical information or understanding. When such studies are actually performed within the Executive branch, they are rarely made available to Congress or to the public. As a result, Congress is frequently presented with information sufficient for only a narrow range of options; typically to fund the project, to cut appropriations by some arbitrary percentage showing mild disapproval, or to kill it.

Congress expects that the new Office of Technology Assessment will help it to refine its evaluations of technological projects and programs and to enlarge its range of options in decision-making.

While "technology assessment" has not exactly become a household word, businessmen, scientists, and

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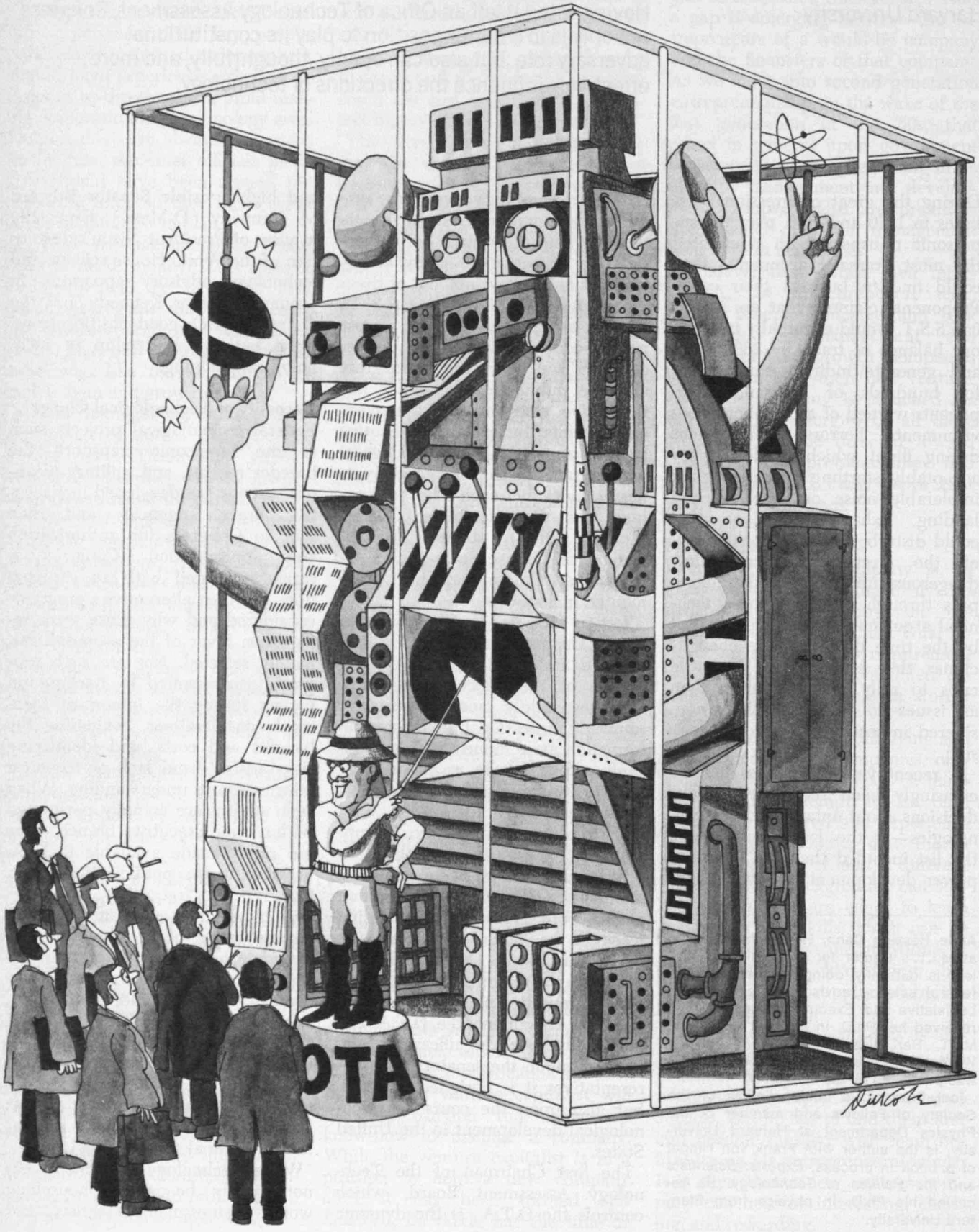
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What we need is "an early warning system to protect man against his own inventions." Technology assessment is the plan to do just that: to help us make decisions "with more confidence and thoughtfulness," say the authors, and help us "raise the level of public debate about the desirability and risks of new technologies." As such, they say, effective technology assessment will give us "confidence in our control over technologies," freeing us to experiment with more alternatives and plans.

engineers who have commented on it often have done so fearfully. Technology assessment is sometimes seen as a conservative, anti-technology weapon. It has been called "technology harrassment" and "technology arrestment." But Congress and the nation as a whole are increasingly faced with a crisis of confidence in government, and particularly in the competence and fairness of our processes of decision-making for technology. The S.S.T. and antiballistic missile system illustrate the fact that as any technology approaches the prototype stage strong pressures for mass implementation are generated by the developers of the technology and by those who stand to benefit from its utilization. The practice of housing responsibility for development, promotion, and regulation of a technology in the same federal agency—for example, the space shuttle in the National Aeronautics and Space Administration and nuclear reactors in the Atomic Energy Commission—increases such technological momentum and political insulation. We must acquire the political maturity and the will to regulate and support existing technologies in the widest public interest. Otherwise, we may hesitate to develop new technologies for fear we will not be able to control them.

The physicist Murray Gell-Mann has expressed the situation in these terms: "It used to be true that most things that were technologically possible were done . . . Certainly, in the future, this cannot and must not be so. As our ability to do all kinds of things and the scale of them increase—for the scale is planetary for so many things today—we must try to realize a smaller and smaller fraction of all things that we can do. Therefore, an essential element of engineering from now on must be the element of choice."

It is in this element of choice that the O.T.A.'s impact can be the greatest.

Early Warning System

"Technology assessment" is the systematic effort to estimate the intended and unintended effects and the immediate and long-range consequences of a particular technology. The father of the O.T.A., Emilio Daddario, former Democratic Representative from Connecticut and Chairman of the Subcommittee on Science, Research and Development of the House Committee on Science and Astronautics, has defined technology assessment as "a form of policy research which provides a balanced appraisal to the policy maker. Ideally it is a system to ask the right questions and obtain correct and timely answers."

In a statement accompanying his first technology assessment bill in 1967, Mr. Daddario pointed out that as early as 1830 the federal government began to assess technology. A series of boiler explosions on steamboats had brought pressure on Congress to take some remedial action. Lack of information on why the boilers had burst led to a $1500 federal grant to the Franklin Institute of Philadelphia to investigate the design, construction, and theory of steam boilers. The Institute made valuable suggestions concerning the design of safer boilers and also proposed new regulatory legislation, which Congress later enacted. This early episode shows that technology assessment can be useful. It also emphasizes that most past assessments were made only after the technology was introduced and undesirable consequences had reached serious proportions.

Mr. Daddario wants technology assessment to be what he calls "an early warning system." This connotation apparently derives from Jerome Wiesner, now President of the Massachusetts Institute of Technology, who in 1965, while serving on the research management advisory panel to the Daddario subcommittee, remarked that what America needs is "an early warning system to protect man against his own inventions." The comment struck a responsive chord, and the subcommittee's report for 1966 explicitly mentioned the words "technology assessment" for the first time in a public document. Thus, one function of technology assessment is to provide early warning of the unintended consequences of new technologies.

A second role of such assessments is to identify economic externalities. American enterprise traditionally has charged the direct costs of production, plus profits, to the purchaser of its products and has passed the indirect costs (externalities) on to the nation as a whole, often most particularly to those individuals who were unfortunate enough to live nearest the polluting industrial plants or strip mines. This tradition has recently become disreputable. Nevertheless, it is in the nature of the competitive system to reward financially the producer whose costs are lowest—and, in the absence of legal regulation or imposed economic incentives to the contrary, costs will generally be minimized by maximizing environmental degradation. It follows that Congress must for each technology legislate the necessary regulations and economic incentives (taxes, fees, and fines).

A third area for technology assess-

Asking the right questions is likely to be the most challenging part of technology assessment. And it is important to keep questioning and assessing a program or project from its conception through its absorption into the society.

ment is in government-supported technology. Here the function is to spell out the intended goals and to analyze the extent to which the proposed technology meets the desired ends. A technological assessment should also propose and consider other technological—and non-technological—alternatives for achieving the desired ends. The development of particular technologies will clearly continue to be greatly influenced by congressional and presidential decisions regarding which projects will be funded. It is thought to be the proper function of the free marketplace in a competitive economy to enable consumers to choose between alternative technologies. As technology becomes more complicated and more expensive, however, increased reliance upon government support eliminates the role of the competitive market and places the choice in the hands of the government. Hence, the need for better technology assessment.

Pushing the Bill

According to Mr. Daddario, all legislation has to go through a certain process. "[First] there has to be a . . . public examination of the idea, then you need the development of a constituency. . . . Finally momentum ties things together so that the legislation is passed."

O.T.A.'s gestation began in March, 1967, when Mr. Daddario introduced HR 6698 proposing the creation of a Technology Assessment Board to be appointed by the President with the advice and consent of the Senate. Although Mr. Daddario asserted that his bill was intended "not as a piece of perfected legislation but as a stimulant to discussion," the bill was largely ignored. To attract more attention to the idea, the Daddario subcommittee held a two-day seminar on technology assessment in September, 1967 to which he invited science policy specialists. These discussions convinced the Connecticut Congressman that it would be desirable to document the need of a technology assessment capability for the Congress. The subcommittee commissioned studies from the Library of Congress (historical case studies), the National Academy of Sciences (philosophy of technology assessment), the National Academy of Engineering (three trial technology assessments), and the National Academy of Public Administration (technology assessment for the Executive branch).

With these documents in hand, the Daddario subcommittee held a series of hearings during November and December 1969 to obtain specific recommendations for the enabling legislation. Not surprisingly, many of the witnesses saw in a new O.T.A. a vehicle for furthering their own bureaucratic goals, roles, and missions. Thus W. D. McElroy, Director of the National Science Foundation, viewed technology assessment as "a bridge whereby the work of the Foundation can be made more broadly useful to society and its institutions everywhere." Technology assessment was a "logical continuation and a reasonable extension of the present assignment of functions in the Legislative Reference Service" to L. Quincy Mumford, the Librarian of Congress. And Alvin M. Weinberg, director of the Oak Ridge National Laboratory, speculated on "what instrumentalities—in this case laboratories—might be needed actually to do the work that the National Academy of Sciences report visualizes needs doing."

The O.T.A. bill that subsequently emerged from the Daddario subcommittee was favorably reported in 1970 but died before reaching a floor vote when the 91st Congress ended. Essentially the same bill was re-submitted in 1971 by Representative John W. Davis (D-Ga.), who became Chairman of the Science, Research and Development Subcommittee after Mr. Daddario left Congress in 1970 to run, unsuccessfully, for Governor of Connecticut.

A major reason why the bill suddenly moved forward quickly in 1972 was that it found powerful sponsors. Mr. Davis is an old friend of William Colmer (D-Miss.) who was at that time Chairman of the crucial House Rules Committee. Senator Kennedy and his National Science Foundation Subcommittee produced the Senate version with the help of the then Rules Committee Chairman B. Everett Jordan (D-N.C.); and without opposition from either party's leadership the bill passed in a voice vote.

By the time the O.T.A. bill was passed by the 92nd Congress, several important changes had been made. The most significant alteration is the complete independence of O.T.A. from the Executive branch. Instead of the Technology Assessment Board being appointed by the President, the legislation created a board composed entirely of legislators, except for a board-appointed director. Where the original Daddario bill provided for a 12-member General Advisory Council appointed by the President, now 10 of the Council's 12 members are appointed by the Board.

Explicit statements that the Office of Technology Assessment is to be an arm of Congress, to serve Congress, were made by Mr. Mosher and others during the floor debates

in both Houses. While congressional fears of "erosion of its constitutional authority" stem in part from the normal tensions between a Democratic Congress and a Republican President, these stresses have been exacerbated by the Executive departments' less than cooperative attitude toward making data available in answer to congressional requests. Thus former Senator Jordan hoped that "an O.T.A. would reduce the dependence of Congress on the Executive bureaucracy and other groups, many of whom have special, vested interests either for or against certain legislation."

Congress has had its own sources for scientific and technical information: hearings and the Congressional Research Service. But these traditional sources have proved inadequate to right the imbalance between the two branches of government. At legislative hearings scientific witnesses and experts frequently testify in a procession, one after the other, with no opportunity to rebut each other's arguments. Often the experts address themselves to different aspects of the problem and in effect talk past each other. In the antiballistic missile debates, for example, the scientist-proponents emphasized the Russian or Chinese threat and the consequent need for some sort of A.B.M., while opponents argued that the A.B.M. system under consideration was inadequate to meet the purported need.

The Congressional Research Service (C.R.S.) and particularly its Science Policy Research Division (established in 1964) and Environmental Policy Division (established in 1969) were intended to supply congressional needs for scientific and technical information. There are several reasons why the C.R.S. has not been able to fulfill this role. For one thing, it relies almost exclusively on published documents, generally ignoring the most relevant information and the most reliable judgments which can be best obtained directly from the experts. C.R.S. reports are typically reviews of information available in the Library of Congress or elsewhere in the government and include uncritical summaries of pro and con arguments. Few Congressmen deal directly with the C.R.S.; normally it functions as staff to staff. Under these circumstances it is difficult to attract the most capable people to the C.R.S.

By working directly under the supervision of the Technology Assessment Board, by performing studies for the Board and for other congressional committees, and by contracting out for the actual technology assessments, the O.T.A. should be able to avoid these pitfalls.

Independent Advisors

Established within the Legislative branch, the Office of Technology Assessment is independent of any other agency and responsible only to Congress. The O.T.A.'s Technology Assessment Board, charged with the formulation of policy, consists of 13 members: six Senators and six Representatives, three from each party in each House, and the O.T.A. Director, who is appointed by the Board. The Board Chairman during each odd-numbered Congress will be a Senator and during each even-numbered Congress a Representative. When the 93rd Congress convened in January, the chairmanship went to Senator Kennedy by reason of his seniority.

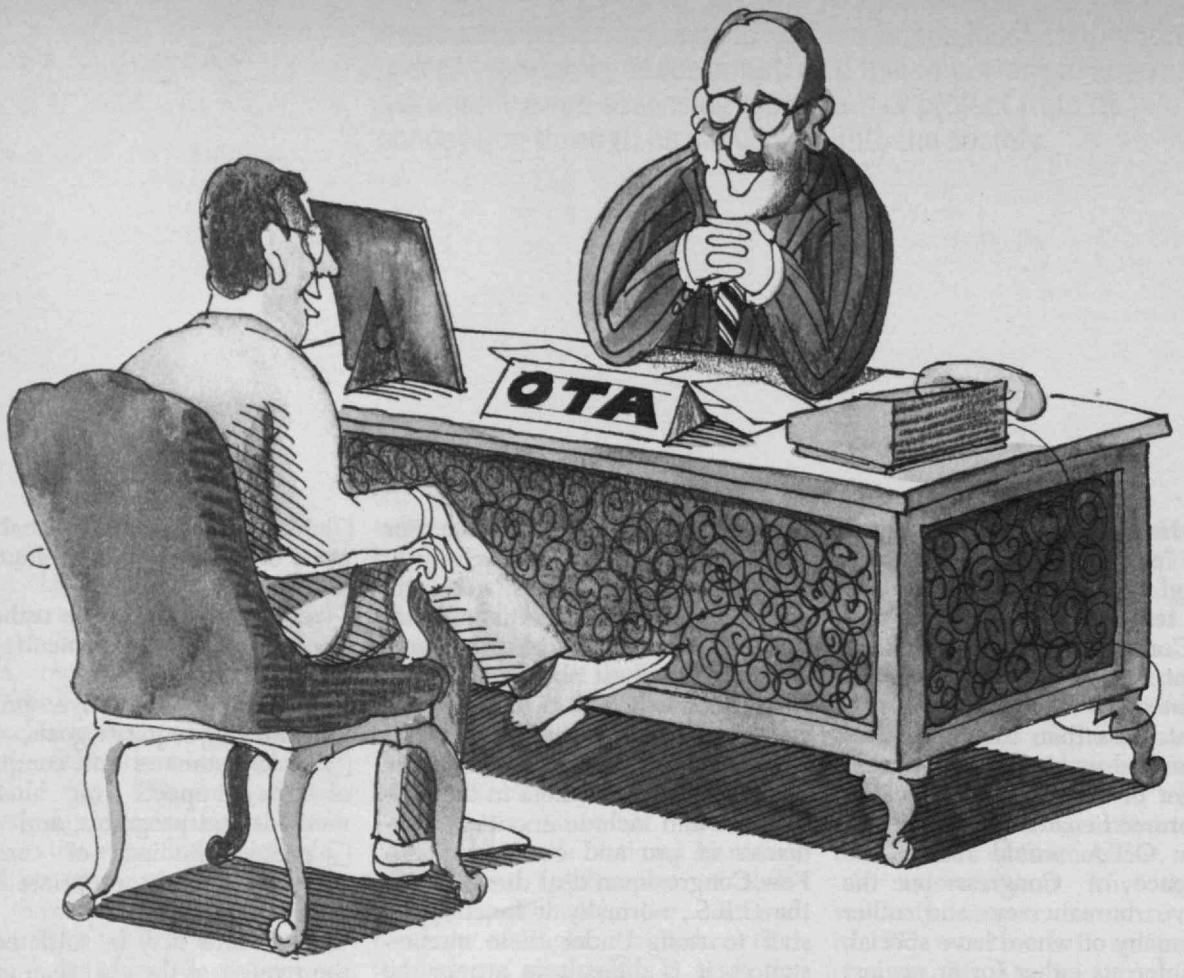
According to the enabling legislation the major functions of the O.T.A. are to:

- ☐ identify existing or probable impacts of technology or technological programs,
- ☐ determine alternative technological methods of implementing specific programs,
- ☐ determine alternative programs for achieving requisite goals,
- ☐ make estimates and comparisons of the impacts of alternative methods and programs, and
- ☐ present findings of completed analyses to the appropriate legislative authorities.

Assessments may be initiated upon the request of the chairman or ranking minority member of any Congressional committee or a majority of the committee members, by the Board, or by the O.T.A. Director in consultation with the Board.

The bill authorizes a budget of $5 million for fiscal years 1973 and 1974 (from July 1, 1972 to June 30, 1974). However, since the Office is not expected to receive its initial appropriation until May or June 1973, almost the entire $5 million should be available for the first actual year of operation. Even the small initial staff will at least double the technical manpower on the congressional payroll. The Office is expected ultimately to employ 40-60 professionals.

Much of the O.T.A.'s effectiveness will depend upon its first director. When queried about the qualifications for such a post, Mr. Daddario said the Director "must be highly respected by the scientific and technical community, he needs to be knowledgeable of the legislative process, aware of the Executive branch and have some relationships of trust and confidence with the private sector." By all objective appearances, the "father of the O.T.A." himself seems eminently qualified to



Technology assessment is the systematic effort to estimate the intended and unintended effects and the immediate and long-range consequences of particular technologies. "Ideally," says former Congressman Emilio Daddario, "it is a system to ask the right questions and obtain correct and timely answers." (Illustrations by Dill Cole)

fill the post and must be considered a leading candidate.

The legislation also creates a Technology Advisory Council to provide liaison between the O.T.A. and the public, including the scientific and engineering community. The 12-member Council will consist of 10 "public" members appointed by the Board, the Comptroller General (who heads the General Accounting Office), and the Director of the Congressional Research Service of the Library of Congress. The Council is to review the findings of any assessments made by or for the O.T.A. and to undertake any additional activities the Board requests. The latter provision suggests a potential for expansion of the Council into a general science advising committee for Congress, operating under the supervision of the Technology Assessment Board.

Senator Kennedy's staff specialist on technology has indicated that a system of specialized panels on various aspects of technology and science may also be established, reporting through the Advisory Council. Additional ad hoc panels may perhaps be appointed to prepare special reports —for example, on technical issues relevant to particular pieces of legislation. The O.T.A. advisory structure would then resemble that of the recently abolished President's Science Advisory Committee and its panels, which operated in conjunction with the also defunct Office of Science and Technology in the Executive Office of the President. The O.T.A. should, however, avoid the excessive confidentiality and the self-perpetuation of membership frequently characterizing Executive branch science advisory committees.

Informal requests have been made to the National Science Foundation for selection criteria for the O.T.A. advisors: what kind of balance should be struck between natural and social scientists, economists, engineers, lawyers, women, minorities, and youth. Mr. Daddario has urged that the Council members not be "those who have constantly been advising the Executive branch." This statement presumably reflects more than just the desire to involve new talent in government service. The separation of powers is essential to the proper working of our government, and it is desirable that the O.T.A. recruit advisors and assessors who are independent of Executive agencies and their programs. Because of his long-standing friendship with Senator Kennedy, M.I.T. President Wiesner seems a likely choice to become a member—and perhaps the first Chairman—of the Advisory Council. (The Council will elect its own Chairman.) Although Dr. Wiesner was Science Advisor to President Kennedy and, for a short time, to President Johnson, he and many other former advisors are estranged from the current administration—partly for political reasons and partly because Mr. Nixon just does not seem interested in their advice.

Continuous Assessments

Asking the right questions is frequently the most challenging and creative part of research, and this seems likely to be true in technology assessment. In the abortive develop-

ment of the U.S. supersonic transport, for example, the problem of excessive engine noise on takeoff and landing was stressed in technology assessments performed as early as 1960. It was specifically mentioned in President Kennedy's initial message to Congress on the S.S.T. (See "Scientists, Politics, and the S.S.T.," by Joel Primack and Frank von Hippel, *Bulletin of the Atomic Scientists*, April 1972.) But as designers encountered serious difficulties in trying to construct an economic aircraft environmental factors were disregarded. The history of the S.S.T. thus illustrates the need for *continuous* technology assessment.

One of the most serious deficiencies in the present system of ad hoc advisory committees and commissions is that while the committees come and go the problems remain. Hopefully, the O.T.A., like the General Accounting Office in its own sphere, will be able to help the Congress and the nation keep a watchful eye on developing technologies even when they are not being "assessed." The annual report to be submitted by the O.T.A. to Congress could be an excellent vehicle for statements on continuing and follow-up assessments as well as needed new assessments.

Unfortunately, before a new technological device actually comes into being, discussion of its potential consequences is necessarily theoretical. Even for existing technologies it is difficult to anticipate the consequences of great changes of scale (from 1 to 10^8 automobiles is a considerable extrapolation) and of the interactions with society and with other technologies. It is to be expected, therefore, that the O.T.A. and its Advisory Council will play a major role in suggesting and structuring technology assessments.

Hopefully, the openness of the technology assessment procedure will enable scientists and non-scientific citizens to follow the developing discussion and contribute their thoughts. Again using the S.S.T. as an example, the potentially serious impact of nitrogen oxides from the S.S.T. exhaust on the ozone layer in the stratosphere was not recognized until early 1971. The Department of Transportation, to its credit, is now funding a major research program on this and other environmental impact questions. But such fundamental research, the results of which must provide the foundations for technology assessments, should ideally be well underway long before political, technological, or societal crises occur.

The actual technology assessments will be performed under contract to O.T.A. (possibly with N.S.F. support in some cases) by interdisciplinary groups at universities, at independent federal laboratories (for example, the Atomic Energy Commission National Laboratories), or at private research centers. Executive branch agencies and private firms have for some time been utilizing the services of such centers to perform studies on limited questions—for example, the environmental impact of siting a nuclear reactor at a particular location. However, the methodology even for such partial assessments is not fully developed and no group has much experience performing full-fledged technology assessments.

Since one of the principal goals of the O.T.A. during its first few years is to encourage the development of technology assessment capabilities, the Office can be expected to spread its contracts widely among a variety

The O.T.A. is a potentially powerful tool for Congress, its successes depending on the political acumen and technological wisdom of its first director.

of institutions. Hopefully, it will announce proposed technology assessments and solicit proposals openly and vigorously to encourage newcomers and to foster the pursuit of excellence.

Inevitably, large questions will have to be broken up, with partial assessments being performed by different organizations. In such cases, the O.T.A. staff in preparing the final combined technology assessment will have considerable freedom to emphasize or ignore conclusions in the partial assessments and thus to determine the complexion of the final report. It will be impossible, indeed undesirable, to avoid such choices, for some findings will be more far-reaching or more important than others. But it is also essential that a competent and thorough review process—participated in and possibly conducted by the O.T.A. Advisory Council—be instituted to guard against inferior or biased assessments.

A particular sort of bias is endemic to specialized studies, and therefore must especially be guarded against. Hugh Folk, Director of the Program on Social Implications of Science and Technology at the University of Illinois, has described the problem pungently:

"It is inevitable that experienced experts will usually be drawn from the interests involved in a problem. In many instances the experts will have created the problem. The A.S.E.B. [Aeronautics and Space Engineering Board of the National Academy of Engineering] appears to be incapable of entertaining an idea injurious to air transport. Just as automotive executives and engineers could not generate any interest in automotive safety, so these men cannot generate any interest in quiet. They perceive the problem in terms of 'tolerable noise' . . ."

Institutional and professional biases are at least as potent as financial conflicts of interest in distorting one's conception of a problem. Even in the absence of any overt bias, people used to thinking about a certain area will tend to see it in the context of a large set of implicit technological, social, and political assumptions. Scientific generalists and politically as well as technically sophisticated laymen will have to be included on technology assessment panels if new technological alternatives are to be considered and presuppositions about political practicality questioned.

Secret Assessments?

In the end, the best review process will be open publication of technology assessments and of the data and preliminary studies upon which they are based. Perhaps new journals should be established for this purpose. An additional special newsletter could publish brief accounts of completed technology assessments, progress reports, and announcements of proposed new assessments. It is only after a report is published with supporting documentation that others are able to point out its flaws and correct it. In this way, we hope to see the development of technical consensuses upon which technological progress can be more securely based.

Because of the great desirability of openness in technology assessment—and in government generally—it is disquieting that the open publication requirement of the House-passed O.T.A. bill was amended in the Senate. The law now stipulates that assessments and related documents *shall* be made available to the initiating congressional committee, but *may* be made available to the public, subject to security statutes, the limitations of the Freedom of Information Act, and (as the Conference Committee report, HR Report 92-1436, explains) the option of the initiating committee. The decision on whether to make the reports and documentation public rests in each case with the Technology Assessment Board. It is important that the Board interpret the limitations on full publication very narrowly.

Of course, the O.T.A. will occasionally be asked to do a study where much of the basic data are secret—corporate proprietary information, for example, or material classified for reasons of national security. Such information will certainly be withheld from the O.T.A. unless its possessors feel that it can be adequately safeguarded. Since O.T.A. studies will not be credible unless they are based on *all* the relevant data, secret as well as public, it is essential that the office rapidly establish its competence in this area and develop open lines of communication with the Pentagon and with private industry. This clearly requires that some O.T.A. reports be kept secret, at least in part. A definite procedure should be established for such cases—for example, simultaneous preparation of a "sanitized" report for public release. While omitting secret data, the public version would include the O.T.A.'s unclassified analyses, conclusions, and recommendations.

We hope that occasions where the entire O.T.A. report is withheld will be very rare. If such a withheld report is leaked the consequences could be unpleasant: powerful congressmen could be offended, agen-

cies supplying the secret information could become uncooperative, the O.T.A. could be discredited in the public eye for withholding the report, and the issues discussed in the report would probably be eclipsed by the furor over its release.

Politics of Technology

The O.T.A. is required to consider requests for government support of technological projects, and decisions on regulation of private technology. The problems in these two areas are rather different. In considering requests for support, the proposed project must be assessed in terms of its ability to meet intended goals, and compared with alternative technological (and non-technological) approaches. For example, if a major goal of the S.S.T. is to reduce air travel time, then the expenditure of government funds to support this project must be weighed against equivalent government support for better ground transportation to airports, better airport design, and better air traffic control. In considering proposed projects, it is also important to focus upon the virtues and defects of the actual design, and not allow the project's sponsors to divert attention to the promise of some hypothetical flawless device. On the other hand, it is also necessary to experiment—the Kitty Hawk flight was an essential early step in air transport. One role of the O.T.A. is to distinguish for Congress between projects that are essentially technological experiments and those likely to have immediate utility.

In government regulation of technology, the hardest problem is to be even-handed in dealing with competing technologies. If, for example, nuclear energy is regulated severely because it is a new and uncertain technology, then the likely result will be to encourage the use of fossil fuels for electric power production. If we desire to reduce the level of pollution from fossil fuels, then the government must embark on a program of regulation (for example, the proposed sulfur tax)—assuming the technology is available for cleaning up the pollution at reasonable cost. Where such technology does not yet exist, the best strategy may well be for the government to support the needed research and development directly, rather than to try to stimulate it through regulation or taxation. It is the job of the O.T.A. to help Congress make these choices.

Of course, such choices will not be made in a political vacuum. Powerful political and economic interests will be affected and they will certainly make their influence felt. And it is appropriate that important decisions on government support or regulation of technology be made in the political atmosphere of the legislature rather than by "experts," for the larger political issues will almost always outweigh the purely technical considerations. Indeed it is usually inappropriate to consider the technological aspects of public problems in isolation. As Harvey Brooks has observed:

". . . the automobile created suburbia and the ghetto, but suburbia also created the automobile by changing it from a luxury to a necessity. Yet neither process was inevitable. They were assisted by a multiplicity of conscious, though dimly understood, political decisions—public subsidy of single-family housing, tax policies, zoning regulations, construction standards."

The Technology Assessment Board resembles a congressional joint committee in being composed of senators and representatives and in having the authority only to conduct investigations, not to report legislation or appropriations (only the Joint Committee on Atomic Energy is a legislative committee). It is hoped that the Board will follow the example of the Joint Economic Committee in energetically pursuing its objectives and in encouraging the O.T.A. to consider potentially controversial issues. If the Chairman and members of the Board fail to devote sufficient time to it, or if they adopt an attitude of overdeference to powerful House and Senate committee chairmen, then the influence and usefulness of the O.T.A. will be greatly diminished.

Hazards of Precociousness

For its first year or two, the O.T.A. perhaps ought to avoid grappling with issues with which powerful senators and congressmen are already publically identified. For example, the Nixon Administration may soon reintroduce the S.S.T. issue, a subject which has intensely emotional overtures for many prominent legislators. An O.T.A.-commissioned technology assessment of the S.S.T., no matter how expert, judicious, and comprehensive it might be, is sure itself to become embroiled in controversy. The most serious consequence of a precocious O.T.A. stepping on powerful toes could be a damaging reduction or a catastrophic elimination of the Office's appropriations.

In its eagerness to avoid antagonizing influential members of the legislature, the O.T.A. must avoid the opposite pitfall of dealing only with non-controversial issues. It appears that O.T.A.'s wisest course would be to commission its initial studies in

areas that may have far-reaching implications but where congressional thought has not yet crystallized into political positions. They might consider technological forefront areas, such as fusion technology and biological cloning. A more prosaic example is noise pollution. As the O.T.A. grows into an established and respected congressional arm, it will hopefully gain sufficient public support and confidence to take a less timorous stance.

Some have conjectured that the O.T.A. will become innundated with congressional requests for assessments, many senators and representatives seeking to obtain an "O.T.A. Seal of Approval" for their favorite programs. However, it seems likely that the opposite is more probable. Each congressional committee jealously guards its own prerogatives and is unlikely to welcome assistance from "outsiders." This may lead to a situation where the initial congressional committee requests may be only for assessments of innocuous and trivial issues. The challenge for O.T.A. will be to win congressional approval and at the same time earn a reputation for dealing ably with important issues.

Confidence in Control

In setting up the O.T.A., Congress has given itself a new and potentially powerful tool. How well the O.T.A. serves its congressional creators depends largely upon the abilities of its first Director and upon how quickly the Office establishes a reputation for competence and integrity.

Reasonable expectations for the O.T.A.'s success lie somewhere between the extravagant claims that the Office will usher in a new millenium for Congress and the out-of-hand dismissal that "this is going to add one more boondoggling board to what we already have." If history serves as an example, the more rapturous congressional expectations are not likely to be met. When Congress debated the Budget and Accounting Act of 1921, which established its General Accounting Office (G.A.O.), one congressman said that he could conceive of "no official of the United States who would have more power than the Comptroller General." Only recently, 50 years after its inception, has the G.A.O. begun to take on the vigor and effectiveness envisioned for it by the Congress.

The O.T.A. presumably will have to rise to prominence faster than that, else it will wither of neglect. There has long been a need for a mechanism like O.T.A. to provide Congress and the nation with a source of digested information and sound judgment on present and future technological problems. The technical community should welcome and support this effort.

Fears that "assessment" is but a polite word for opposition should soon be proved false. The nation can never return to the halcyon days of its industrial youth, when technological laissez-faire was fostered. In the future we must learn to choose more carefully the technological paths we wish to pursue and to make adequate provisions for the people whose interests or jobs are affected by the choices. Technology assessment can allow decisions to be made with more confidence and thoughtfulness, and it certainly should raise the level of public debate about the desirability and risks of new technologies. Only if we have confidence in our control over technology will our society be willing to experiment with the new technologies that will undoubtedly be necessary to improve the quality of life.

Suggested Readings

The philosophical foundation for the concept of technology assessment is contained in *Technology: Processes of Assessment and Choice,* prepared by the National Academy of Sciences for the Committee on Science and Astronautics, U.S. House of Representatives, July, 1969. It was written by a panel chaired by Harvey Brooks, Dean of Engineering and Applied Science, Harvard University.

Technology Assessment for the Congress (Committee on Rules and Administration, U.S. Senate, November 1, 1972), the most recent congressional publication on technology assessment, contains an extensive bibliography.

An iconoclastic essay is Hugh Folk's "The Role of Technology Assessment in Public Policy," published in *Technology and Man's Future* (Albert H. Teich, Editor), St. Martin's Press, 1972.

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The U.S. Superport Controversy

The arguments in favor of berthing super-size tankers are economic; the arguments against are environmental. At least technically, a reconciliation may be possible.

In the five years from 1965 to 1970, the number of ships in the world fleet with capacities in excess of 100,000 deadweight tons (dwt) increased from 19 to 319. Before this decade ends, according to the U.S. Maritime Administration, their numbers should easily exceed 1000. By then, the 200,000-300,000 dwt tanker and combination-bulk carrier will become the standard workhorses of world bulk trade, as implied in the illustration on p. 52.

This trend to large vessels is inexorable. J. H. Kirby, Managing Director of Shell International, says: "There can be no thought of abandoning big tankers and returning to 50,000-tonners. . . . [The] demand for crude oil is growing at such a rate that it would be impossible to provide sufficient trained crews for [the smaller vessels] even if they could be built. The ports of the world would become hopelessly congested with them. Thus, the 200,000-to-300,000-tonners are before us and here to stay."

The largest tanker in service now is the 372,700-ton *Nisseki Maru* of the Tokyo Tanker Company. But it should not hold the record long, for a 477,000-ton tanker was scheduled to begin operations for Globtik Tankers, Ltd., about the time of publication of this article. Globtik has another vessel of 500,000-700,000 dwt in the planning stage.

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A recent study by Soros Associates for the Maritime Administration has documented the cost savings of using large carriers (shown in the chart on p. 53). Economies of scale in oil transport are such that even allowing for terminal and transshipment costs an increase in tanker size from 65,000 tons to 325,000 tons could reduce the overall transportation cost of Persian Gulf oil from about $9.93 per ton to $7.42, a savings of over 25 per cent.

Bulk shippers, with the oil industry in the lead, will continue to use large vessels to reduce transportation costs. By using supersized bulk carriers the major industrial nations, particularly Japan and those in Europe, have been able to depend increasingly on distant sources for their raw materials.

Already, the economies of large ship transportation—particularly in the movement of low-value bulk commodities such as coal, oil, and iron ore—have stimulated the construction and planning of more than 50 foreign deepwater port facilities capable of accommodating vessels of 200,000 dwt and larger (the illustration on p. 56 shows recent port development trends in Europe). In the United States, bulk vessels of 100,000 dwt can presently enter and berth safely at only three developed ports—all on the West Coast. The East and Gulf Coasts have no comparable facilities (see illustration on p. 56).

Only 12 years ago, Japanese and European ports were limited to 35,000-45,000 ton vessels. At that time the ports of the U.S. East and Gulf Coasts were the world leaders in bulk carriers then in service. Today the United States is virtually surrounded by nations with ports that can accept super-sized vessels. In those foreign ports where adequate natural harbor and channel depths are not available, transfer terminals have been constructed, often several miles offshore to attain the necessary deep water. In many countries dealing in the iron ore, coal, and crude oil trades, the guiding philosophy of such developments is that the port which expands the fastest will get the bulk cargo business of the future.

How should the U.S. respond to this trend? Is it really necessary for the world's largest industrial trading nation and consumer of energy to have the ability to receive supersized tankers and bulk carriers? What would be the major consequences for the U.S. if no deepwater facilities were provided to handle these ships?

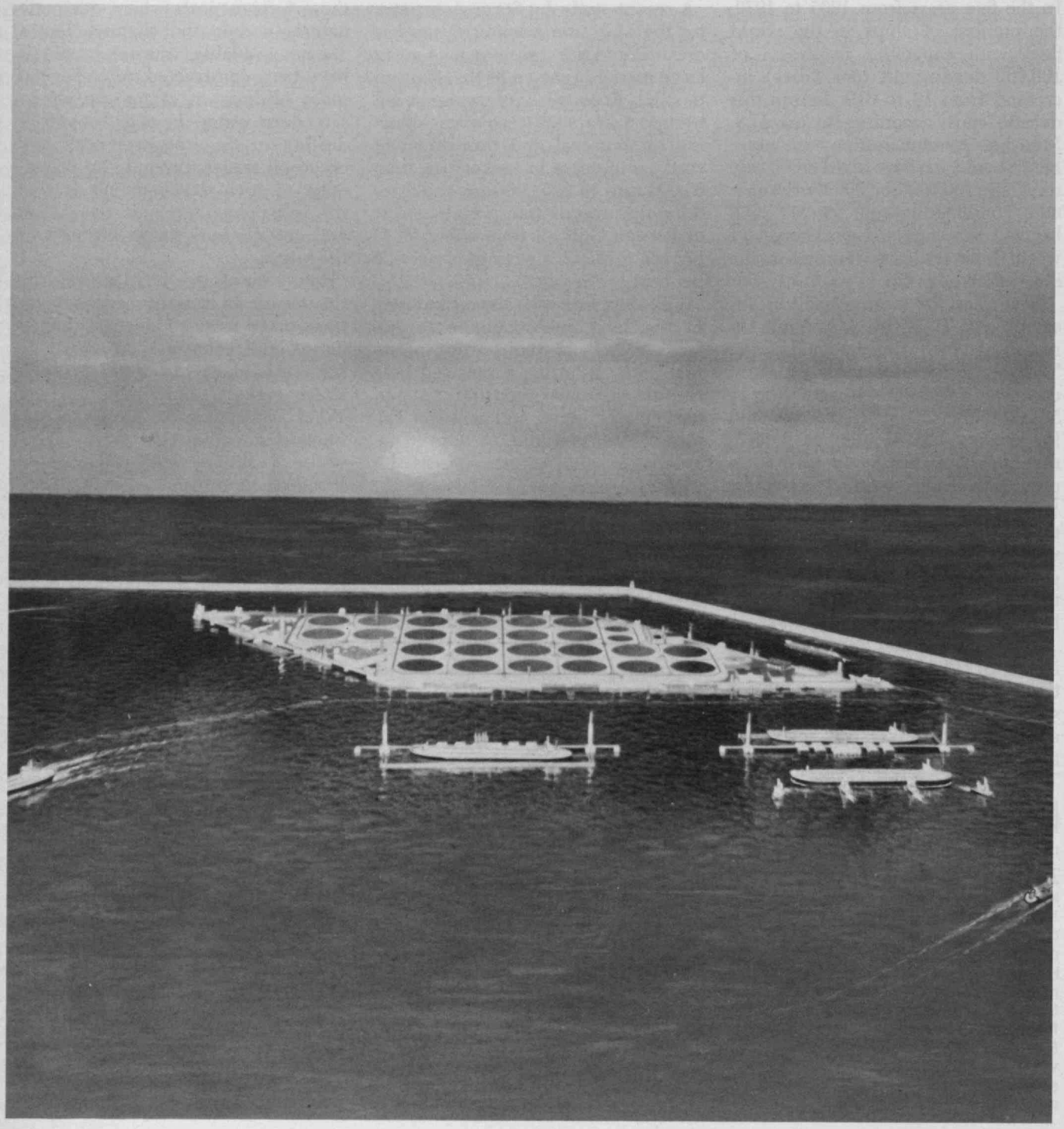
Tons Up, Dollars Down

Since World War II a major segment of the U.S. industrial base has become increasingly dependent upon the oceanborne importation of raw materials. Almost 90 per cent of this tonnage presently consists of bulk cargoes, the majority passing through Atlantic and Gulf Coast ports.

The Texas Gulf Coast contains the greatest concentration of oil refining and petrochemical processing industries in the world. The second largest concentration of refineries in the U.S.—more than 90 per cent of the East Coast's capacity—is located at the Delaware River estuary.

A recent study for the Corps of Engineers by Robert A. Nathan Associates predicts that U.S. seaborne imports of crude petroleum will increase from about 50 million tons in 1969 to nearly 300 million tons in 1980 and perhaps 1 billion tons annually by 2000. This oil will be de-

Capable of handling 300 million tons of oil and a smaller amount of dry bulk cargo a year, this proposed supership terminal 8.5 miles off Cape Henlopen, Delaware, could start operations by 1977 and reach capacity by 1981. Designed for the U.S. Maritime Administration by Soros Associates, it would cost $1.3 billion, a substantial part of which would be for environmental protection. Nevertheless, mainly on environmental grounds, the States of Delaware and New Jersey have opposed superports in their waters.



livered mostly to East and Gulf Coast ports from the Middle East and Africa. "Potential economic savings from the use of supper-carriers," according to the Nathan report, "are of a scale that will effectively compel the use of such tankers for the ocean transport of crude petroleum imports, particularly from Far East, Middle East, and African sources." Consequently, if deep-water port facilities are not available in the U.S., the oil companies can be expected to transship the oil from superport facilities in the Maritime Provinces of Canada or the Caribbean islands.

With the tremendous concentration of industrial activity along the East and Gulf Coasts massive volumes of oil will have to be moved there whether or not deepwater terminal facilities exist. Forced to depend on smaller tankers, the region will suffer significantly higher costs. By 1980, if these ports are still inaccessible to supertankers the industries they serve may become locked into the use of a needlessly inefficient transportation system. Inevitably, these industries will suffer serious competitive handicaps, with far-reaching economic consequences not only at the regional and national levels but also for individual consumers.

The U.S. consumes a large part of the world's output of raw materials. Heavy industry locates where raw materials are least expensive. Therefore, it is essential to bring the transportation savings of supersized vessels to the bulk-producing-and-using industries of the East and Gulf Coasts. Denied these economies, the competitive disadvantages could be significant enough in the long run to drive the affected industries into seeking more favorable locations outside the U.S. The oil industry, for example, could decide to construct new refineries in Canada or other Western Hemisphere locations where superports are available. U.S. refinery operators claim they can phase out an operating plant over a five-year period without excessive losses. Thus, the functions of some of our existing petroleum ports could eventually be reduced to simply storing and distributing finished products.

Any significant change of this kind in the pattern of industrial activity in the U.S. could clearly have an adverse effect on the employment of many thousands of workers who contribute billions of dollars to the regional and national economies. In addition, relocation of industry outside the U.S. and the "multiplier" effects of the concomitant loss of U.S. markets, would undoubtedly cause massive outflows of U.S. capital—exactly how much, we cannot calculate, but it appears safe to estimate that many billions of dollars would ultimately be involved.

These capital movements would be reflected in an adverse effect on this nation's U.S. balance of payments. Moreover, the increased importation of finished goods produced overseas by the relocated industries, in place of the importation of the cheaper bulk-shipped raw materials from which the goods are made, would further tilt the balance against the U.S.

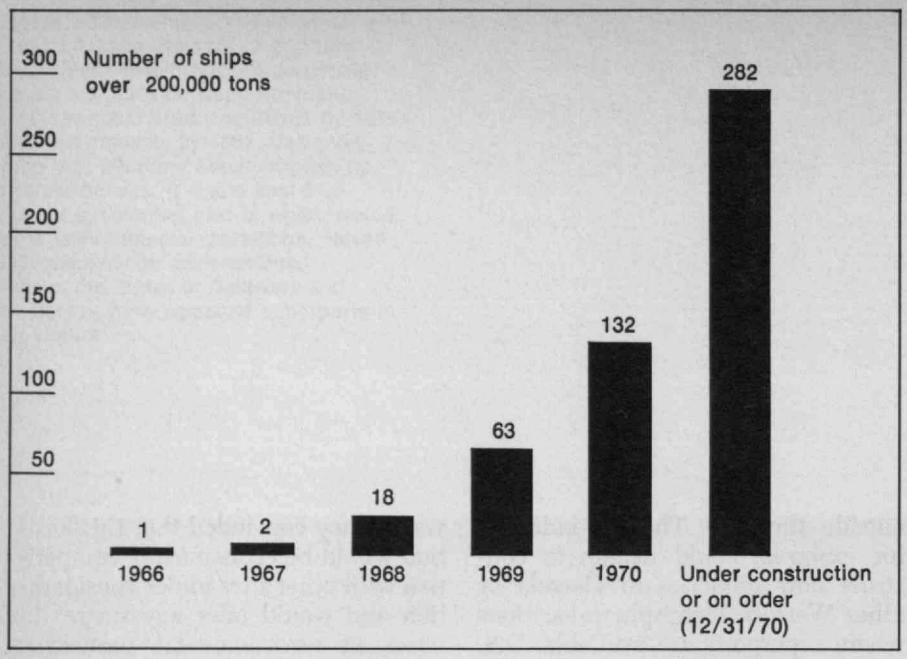
In Deep

In their Maritime Administration study (the final report has not been published as of this writing), Soros Associates considered 32 potential U.S. deepwater terminal sites and chose one outside Delaware Bay, 8.5 miles east of Cape Henlopen, Delaware. They concluded that this location would be economically competitive with other sites under consideration and would offer advantages in terms of environmental protection and minimal ship traffic congestion.

The proposed Delaware superport project, known as N.A.D.O.T. (North Atlantic Deepwater Oil Terminal), would consist of three construction stages. Although the total cost was computed at more than $1.3 billion, Soros figured that annual savings in oil transport costs could exceed $750 million, resulting in an extremely favorable economic investment. The initial stage terminal would consist of an island of about 100 acres, protected from ocean waves by a dog-legged breakwater about 11,500 feet long. The terminal would contain two berths for tankers up to 350,000 tons and would service refineries in the New York-New Jersey area and along the Delaware River. It also would have a pipeline or six shallow-draft berths for 30,000-60,000 ton feeder vessels. At this initial stage the terminal would cost $499 million and would handle 100 million tons annually.

The next construction stage would double the terminal area, the ship facilities, and the oil-handling capacity at a cost of $288 million. The final stage, priced at $531 million, would enlarge the island to 500 acres and lengthen the breakwater by 7,500 feet. In addition to 300 million tons of oil, the terminal would be able to handle dry-bulk commodities, such as iron ore and coal. It would consist of six deep-draft berths for supertankers, two deep-draft berths for dry-bulk carriers, and 13 shallow-draft berths for feeder operations (or alternatively a pipeline network).

The N.A.D.O.T. schedule calls for



Exponential growth of 200,000-ton-or-larger ships as shown on the chart suggests that seaborne cargo transport is rapidly going the way of enormous ships and superports. More recent figures—arriving too late to incorporate into the chart—indicate that the number of such ships in service as of October 31, 1972, was 264 and the number on order or under construction was 366.

construction of the initial stage to start in 1974 and be completed in 1977. The next stage would begin in 1976 and finish in 1978. The final stage would start in 1978 and be completed in 1981.

The Maritime Administration feels that any delay in developing such deep-draft terminals will permit Canada and possibly the Bahamas to secure the necessary support from U.S. industry and markets to justify constructing a deepwater redistribution terminal. Such a project would probably be based on long-term contracts, and once established it would substantially preclude the development of a competitive U.S.-based facility. The Maritime Administration has warned, "That such a vital transportation terminal be owned and controlled by foreign interests and not subject to U.S. jurisdiction would be distinctly undesirable, particularly from a national security standpoint, and would have a deleterious impact upon our world trade posture."

So far we have considered the U.S. only as a transportation user, without regard to American ship construction and operation—at one time a major element in the world maritime picture. In fact, in the Merchant Marine Act of 1970, Congress indicated the need for an American-flag, bulk-vessel fleet to protect our commercial and defense interests by ensuring that the U.S. has enough vessels to efficiently carry a significant percentage of our total bulk-commodity foreign commerce. A major part of President Nixon's new maritime program is the availability of federal subsidies to assist U.S. ship-owners in constructing and operating a modern fleet of competitive bulk vessels under U.S. colors. A major hindrance in the construction of supertankers in this country has been the lack of superport facilities.

Berth of a Supership

What, in practical detail, are the obstacles that prevent supersized vessels from calling at U.S. ports?

The most significant physical constraints preventing large, fully-laden tankers and bulk carriers from entering and berthing at U.S. North Atlantic ports are the depths and widths of entrance channels and harbors. Other major restrictions identified by the Maritime Administration are:

- ☐ Grave risks of collisions or groundings in congested inner harbors;
- ☐ Strong public concern about environmental damage resulting from oil spills;
- ☐ Inadequacy of existing transfer and storage facilities for handling large bulk cargo carriers; and
- ☐ Shortage and increasing cost of waterfront land for expanding terminal capacity.

U.S. port channels are grossly undersized for vessels with drafts greater than 45 feet (generally displacements of 80,000 dwt or over; see the illustration on p. 56). The majority of U.S. ports, particularly those on the Atlantic and Gulf Coasts, are deep enough in their main ship channels and alongside their berthing facilities to accept vessels of only 35-to-40-foot drafts, or about 30,000-55,000 dwt. Relatively few can berth fully laden bulk vessels of 80,000 dwt. So the ships of the massive fleet expected to be in service by 1974—some 779 tankers and bulk carriers over 100,000 tons, requiring depths of at least 55 feet—will be unable to arrive or depart fully loaded at any existing terminal along the entire southern and eastern sweep of the U.S. coast.

On the West Coast, the Port of Seattle can now fully load 250,000-ton bulk carriers with grain at its new 73-foot terminal, and the Port of Los Angeles can discharge tankers of up to 120,000 tons. The Port of Long Beach is deepening its main ship channel to 62 feet at mean low water; it will be the only U.S. port capable of unloading a 200,000-ton tanker at berth. These three West Coast ports are the only ones in the continental U.S. that can handle vessels exceeding 100,000 dwt.

In the last decade the volume of waterborne commerce moving through U.S. ports and the number of vessels used to transport it have increased. The growing density of traffic in these ports poses the constant risk of collisions and groundings, which for oil tankers and other chemical carriers bearing flammable, explosive, or toxic materials can result in loss of life and property and in pollution of valuable adjacent land and water areas. According to the U.S. Coast Guard there have been over 500 tanker collisions world-wide in the last 10 years; 80 per cent of the accidents occurred as the ships were entering or leaving ports. The Coast Guard also calculates that oil spills from tanker collisions average at least a million tons annually and cost about $40 million (*see* Technology Review, *February, 1973, pp. 13-22*).

Superbreak

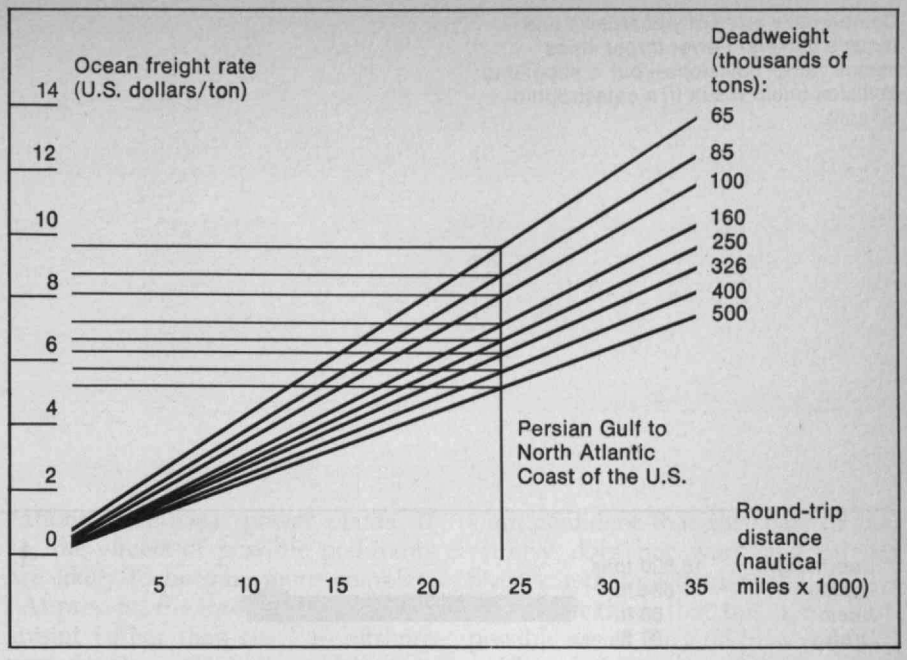
In the continued absence of federal regulations governing marine traffic

control systems, the prospects for even greater human tragedies and pollution disasters become increasingly ominous. It is evident that continued dependence upon voluntary compliance with "rules of the road" and recommended traffic separation schemes will not be adequate to prevent future collisions and groundings. Some form of control and regulation of marine traffic patterns in U.S. ports and harbors is needed. Legislation has been passed that gives the Coast Guard broad authority in controlling the flow of marine traffic and requires radiotelephone communication between vessels in the navigable waters of the U.S.

One of the most important factors in connection with collisions and groundings is the "crash-stop" ability, which has decreased drastically as tanker size has increased. The energy absorbed in stopping a ship is directly proportional to displacement. In today's supervessels engine power has increased less than proportionally; it is chosen for steady, moderate, economical speed. A T-2 tanker of 16,000 tons can come to a standstill from full speed within half a mile in five minutes, while 2½ miles and 21 minutes groan by as a 200,000-ton tanker brakes to a dead stop. It would be hazardous indeed to sail large tankers in port channels designed for the movement of World War II vessels.

In recent years, public awareness of water pollution has increased substantially, although initially it was focused on inland lakes and rivers. The 1967 grounding of the Torrey Canyon off southwest England and the resultant spill of about 18 million gallons of oil brought increased attention to pollution of the world's oceans and shores.

Many Americans are haunted by the thought of a super-size tanker breaking in two off the U.S. coast. Most of them seem not to be worried by the ever-increasing volume of U.S. petroleum imports per se, but they view with alarm the fact that much of this petroleum could be handled by supertankers. A 200,000-ton tanker is sometimes seen as more of a pollution threat than ten 20,000-ton tankers. Supertankers would probably be less subject to collision, mainly because they would be fewer in number, and less apt to go aground since many would be loaded and unloaded at deep offshore terminals. Nevertheless, the potential for a catastrophic spill exists in any supertanker mishap.



With a 24,000-mile round trip between the Persian Gulf and the U.S. East Coast as an example, the freight rate for the largest tanker is half that of the smallest. Such economics make it understandable why monster ships are in demand.

Nowhere is this more evident than in proposals that deep-draft bulk carriers enter North Atlantic port channels. All major North Atlantic ports are surrounded by large concentrations of population. Because their harbors are quite limited in area oil spills are concentrated. Any pollution-causing accidents in such ports will have a great public impact.

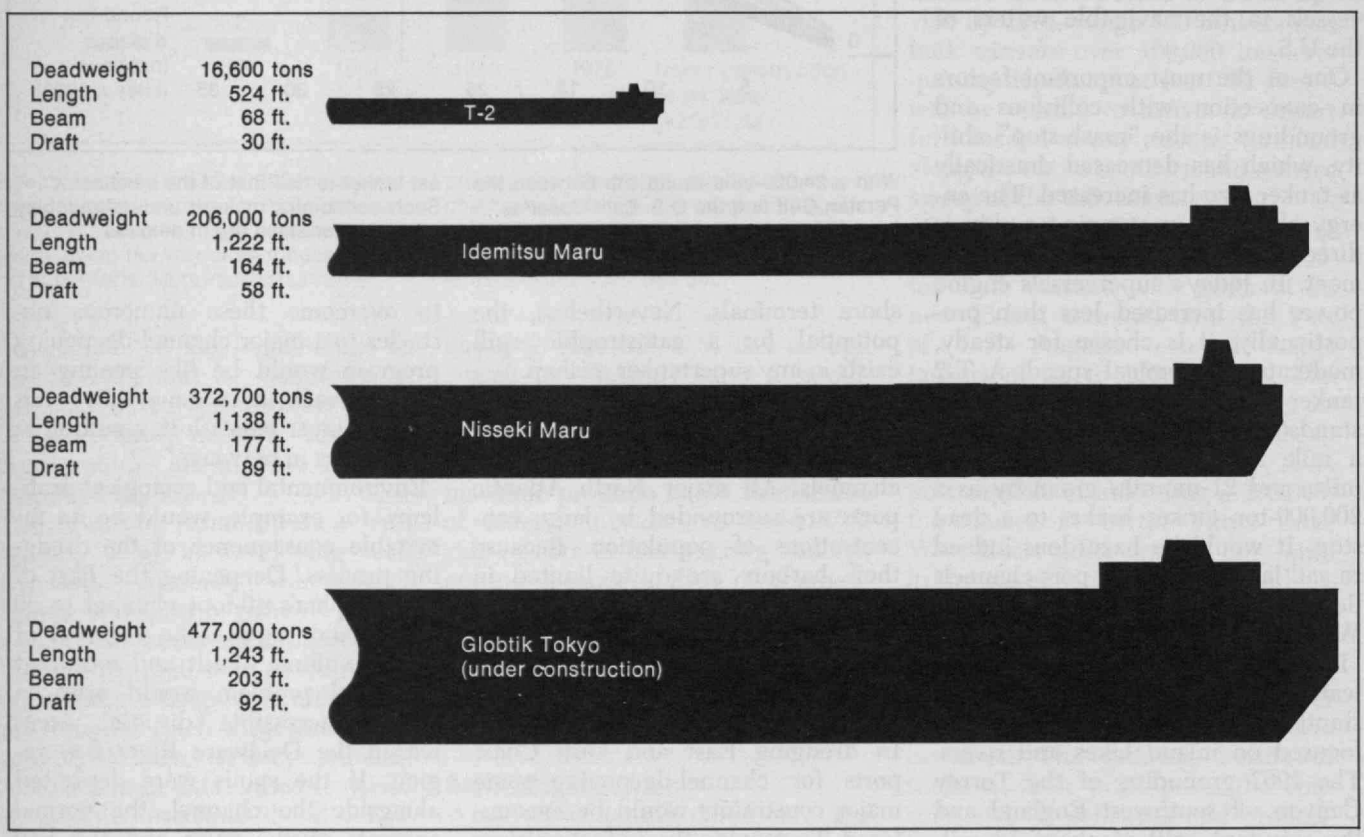
Dredges and Drills

In dredging East and Gulf Coast ports for channel-deepening some major constraints would be encountered. To provide the 75 feet or more of water for ships of 250,000 tons and upward, dredging would have to go 30-40 feet below the present bottom of many ports. It is becoming apparent that the dredging of major ports to such depths is neither economically nor physically feasible. The 35-to-45-foot channels of many major ports may be deepened no more than about 10 feet primarily because of underlying rock, harbor and river tunnels, and a welter of environmental and ecological problems. Not only would a 10-foot increase cost about $500 million per port, but the channels would not be deep enough to accommodate the large bulk vessels of today and tomorrow. A Maritime Administration report has stated that an attempt to overcome these numerous obstacles to a major channel-deepening program would be like peeling an onion—"each layer removed reveals another layer beneath it, resulting in many tears in between."

Environmental and ecological problems, for example, would be an inevitable consequence of the dredging process. Deepening the Port of Philadelphia's 40-foot channel to 50 feet would require the removal of such a volume of silt and rock that a critical problem would arise in finding accessible disposal areas within the Delaware River/Bay region. If the spoils were deposited alongside the channel, the normal currents of the river and the bay might be interrupted. Ecologists are concerned that spoil-dumping in confined oceanic areas may already be creating "dead seas" in those regions. The vast stretches of tidal marsh in the bay would appear to be ideal disposal areas, however they are essential breeding and feeding grounds for fish and wildlife; once such areas are filled—as many have been along the East Coast—they are lost forever as sanctuaries, and the resultant damage to fish and wildlife is frequently extensive and irreversible. If the spoils are scattered over a much greater oceanic area, certain sea life in the affected region, such as oysters and other shellfish, may be seriously harmed.

Shellfish in Delaware and Chesa-

Comparative sizes of yesterday's and today's tankers. Fewer larger ships means fewer collisions—but a supership collision could result in a catastrophic oil spill.



peake Bays, particularly oysters, might be affected by the existence of a deeper channel. The oyster drill, a type of marine snail that comes in from the sea to feed on valuable shellfish, is prevented from penetrating further into the bay by the downstream flow of fresh water. A deeper channel would allow more extensive intrusion of salt water into Delaware and Chesapeake Bays and probably result in considerable drill damage to up-bay oyster beds. Channel deepening might also alter shoaling patterns in the rivers and estuaries.

In fact, the increased salinity along with the deposit of the dredging spoils in the estuaries could dramatically change the entire ecologies in those regions seriously damaging the commercial seafood industry and the very substantial recreational activities of millions of East Coast residents. The dredging itself very likely would stir up and recirculate the pollutants that have settled to the bottom.

The deeper channels would bring about an increase in the salt content of municipal and industrial water supplies. Perhaps more important would be the potential threat to the entire region's aquifers —the underground fresh-water-bearing strata that pass under many of the river beds and bays of the East Coast. The potential danger if the channels are deepened substantially is by no means inconsequential.

Opposed Irregardless

While detailed studies of the above problem areas can be helpful in determining their magnitude, the fact is that they do constitute significant obstacles to adopting a major channel-deepening program. Consequently, superports in the U.S. will probably take the form of offshore terminals.

Although this would circumvent some of the obstacles, offshore terminals would raise a different set of problems. Construction would be more difficult, hence more costly.

Operations, as well as construction, would be hampered by weather and wave action. An offshore terminal would require a system of feeder vessels or pipelines to transport cargo to and from shore. Establishing such a terminal would not require channel dredging, but this is not to say that all possible risk to the environment would be eliminated.

The construction activities associated with offshore terminals would affect the regions' ecologies, probably temporarily, depending upon the types of facilities being built. Construction of floating platforms with submerged connections to shore-based facilities would have the least effect, while the building of piers, causeways, and islands that have fixed connections or bases on the bottom would have greater and longer lasting influences on the ecology of the area.

Local navigation tracks for traffic, commercial fishing, and recreation would be altered. Effects of littoral drift and wave patterns would be influenced by the size, shape, and offshore distance of the facilities. While oil spills at the terminal would be far from the shoreline, thus affording greater dilution and flushing, the problems of containment of spills in the more exposed waters could be greater. Fish populations would probably concentrate around the structures and be more vulnerable to pollutants. The exposure of ships and ports to the weather and seas would be greater, thus increasing the probability of accidents, although an offshore facility located within a bay would be less prone to mishap than one in the open sea.

Offshore terminals could be made into multiple-use facilities including marinas, fishing fleet or aquiculture bases, recreation areas, or even locations for nuclear power plants. If so, the effects of possible pollutants are likely to become more complex.

At present, the most significant constraint (other than cost) to offshore port development is the public fear of oil spills and degradation of the quality of life. Oil spills represent a tangible, visible, direct hazard associated with port development that persons can readily understand and decry. Conservationist, recreational, and some political interests are deeply concerned with safeguarding coastal beaches, wetlands, and marine life. Tourism and recreation are primary industries in many states, and extensive investment in beach resort areas has made every coastal state extremely sensitive to environmental damage from oil spills.

Preserving and improving the quality of life has become an important part of the general environmental movement. In the case of port development, many individuals and organizations are concerned by the realization that a large offshore oil terminal will have secondary influences including the building of refineries. As Congressman Charles W. Sandman, Jr., of New Jersey stated at a public hearing held by the Corps of Engineers:

"Establishing an oil terminal in the lower Delaware Bay, in my opinion, whether there is spillage or there is not, is still objectionable and strenuously opposed by the half million people I represent. . . .

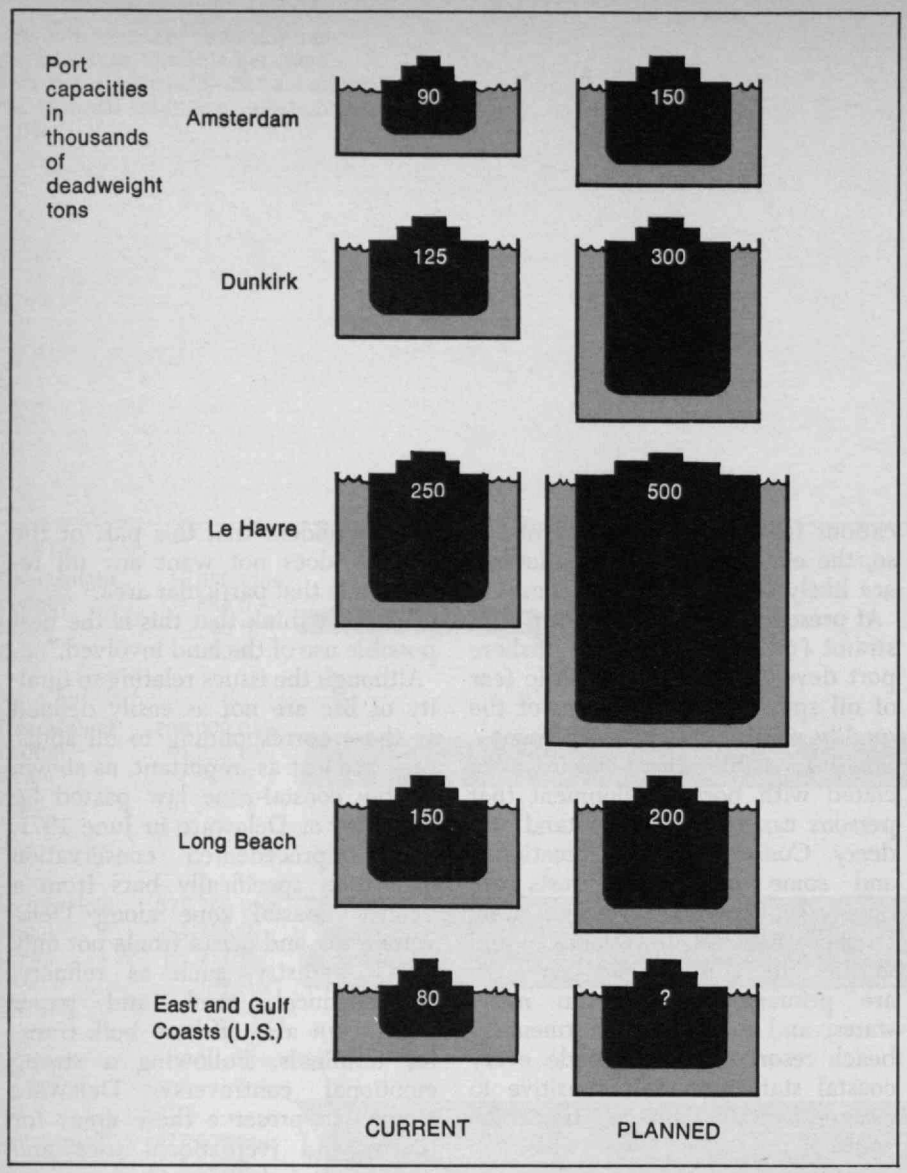
"They are concerned with what is going to be brought in with this particular facility. It is only going to be a foot in the door. First an oil transmission line, then later a great big marine terminal for oil tankers, and then sometime after that there will be . . . some oil refineries there. And I am confident that this part of the country does not want any oil refineries in that particular area. . . .

"I do not think that this is the best possible use of the land involved."

Although the issues relating to quality of life are not as easily defined as those corresponding to oil spills, they are just as important, as shown by the coastal-zone law passed by the State of Delaware in June 1971. This unprecedented conservation legislation specifically bars from a defined coastal zone along Delaware's bay and ocean fronts not only heavy industry, such as refinery, petrochemical, steel, and paper plants, but also offshore bulk transfer terminals. Following a strong emotional controversy, Delaware elected to preserve these areas for tourist and recreational uses and compatible industries. Of this situation Governor Russell W. Peterson of Delaware said: "As far as I'm concerned, even if Shell Oil can build a plant 100 per cent free of pollution, I'm still opposed."

Role Reversal

The immediate impact of the Delaware legislation was to thwart construction of a major new refinery complex and two proposed offshore deep-draft transfer facilities in Lower Delaware Bay, one for exporting coal and another for importing crude oil. (The offshore facility proposed by Soros Associates would be located outside of Delaware Bay beyond the three mile state territorial boundary.) Andrew Gibson, former Assistant Secretary for Maritime Affairs with the U.S. Department of Commerce, has described this legislation as an example of "emotional hysteria." Nevertheless, influenced by the Delaware law, other coastal states have passed or



Because of shallow bedrock, tunnels, and other subsurface utilities, it is not feasible to bring existing U.S. East and Gulf Coast facilities up to superport capability. Thus, offshore island and mooring-buoy terminals are under consideration —and under fire.

are considering similar legislation.

The role of the federal government in superport development is tied closely to problems of energy supply, land-use policies in coastal states, and protection against massive oil spills. History has shown the United States government exhibiting a definite lack of leadership in port development. This is not surprising in view of the fact that more than 24 federal agencies have missions connected with port planning. In addition, some agencies have functions quite the reverse of what one might expect. For example, the Secretary of the Army, through the Corps of Engineers, is responsible for seeing that port facilities are adequate for commercial traffic. It is the duty of the Secretary of Commerce, on the other hand, to allocate available ports and port facilities to meet the needs of our nation and our allies in time of war.

The outcome of this governmental morass is that the nation as a whole has suffered from waste and inefficiency in the construction and operation of port facilities. As a preview of what might soon be expected, a Maritime Administration-sponsored study estimates that by 1975 the U.S. will have a container facility capacity 250 per cent above the expected need (on the West Coast the capacity will exceed demand by 570 per cent).

A similar danger exists in the building of superport terminals to handle oil tankers and bulk carriers. From Texas, where one plan calls for an offshore tanker facility in the shape of the "Lone Star", to the northern part of Maine, some private parties would be happy to see a proliferation of superport facilities. However, government-sponsored studies have shown that the East and Gulf Coasts need only a few superport terminals for maximum benefit to the nation. Conservation interests, on the other hand, may work against construction of any superports along the Gulf-Atlantic perimeter. Clearly, major emphasis must now be placed on devising acceptable plans that will balance environmental safeguards with economic needs and private goals with the commonweal. An eight-agency federal investigation, headed by the President's Council on Environmental Quality, is in fact underway seeking to outline the role of the private and public interests in superport development and to work out a plan of early action.

Resolving the Conflicts

The trade-offs between the two basic types of designs, the floating mooring buoy and the fixed artificial island, may be decided on the basis of ecological impact. The fixed island allows barriers to be placed around a berthed vessel to contain spills. At a single point mooring buoy, the ship would swing with the current and the wind making containment barriers impractical.

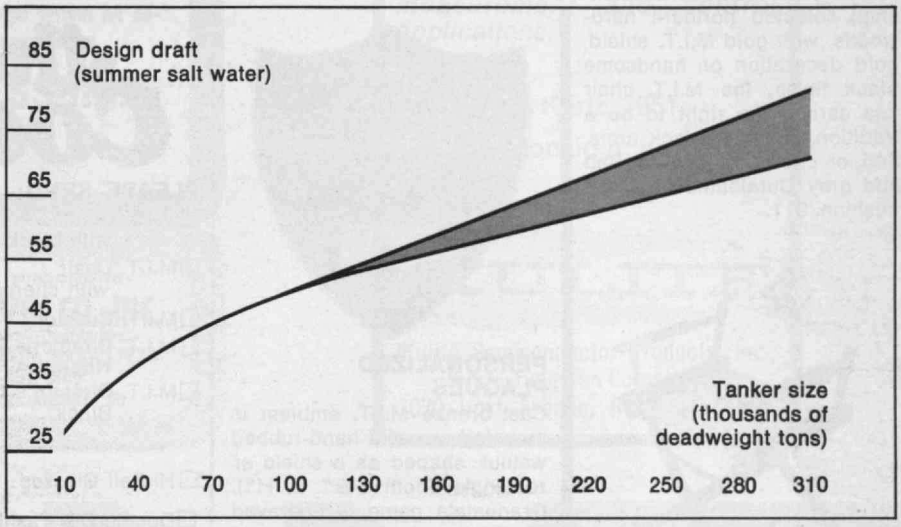
Favoring the mooring buoy, however, is research indicating that after oil is spilled it releases most of its toxic properties within 24 to 72 hours by evaporation and dissolution. If the oil does not reach the biologically productive shore areas for 72 hours major ecological damage is averted. One way to provide a three-day safety factor is simply to place a terminal very far offshore. Naturally, the prevailing winds are an important consideration here. The construction cost of a single-mooring-buoy system (a single berth and storage facilities on shore) would be a fraction of the cost of a multi-berth fixed island terminal. Although there are significant unknowns in the economics of superport construction, there is a crossover point where a multi-mooring-buoy system becomes more expensive than an island terminal of equal capacity. One also must account for the rapid increase of cost with water depth of the fixed island system. If,

therefore, environmental considerations force the siting of superport facilities very far offshore, the probability that a mooring-buoy system will be used will increase with distance and depth.

No matter which engineering design is used, significant resources must be allocated in the attempt to make the facility ecologically safe. In the $1.3-billion offshore island proposed by Soros Associates pollution control systems would represent about 10 per cent of the cost and would include containment booms placed around each berth, spillways on the island to control storage-tank spillages, and a facility for treating oily waste (including ballast water). Advanced traffic control and collision avoidance systems would also be used to protect the ships and the environment.

Ray Brimble, president of the Texas Superport Study Corporation, has estimated that an offshore terminal would provide 300,000 to 500,000 new jobs during the first decade of operation. Although this estimate may be grossly exaggerated, the impact on the community involved would be sizeable in terms of population growth, industrial development, highway construction, traffic congestion, and pollution. The Gulf Coast with its highly industrialized coastal areas may be generally better able to absorb these impacts than the Atlantic Coast with its scenic beaches and tourism.

The overwhelming national interest argues for developing ways of constructing deepwater transfer facilities that are consistent with the integrity of the environment. Given the capabilities of present technology, there appears to be no reason why adequate superport facilities cannot be provided in such a way as to protect adjacent land and water areas from the dangers of pollution. All of this would require a new order of harmonious cooperative planning by federal, state and local government agencies as well as port authorities and private industrial interests. It is the only way to resolve the basic conflicts between economic and environmental needs and values.



Superships need superports; some harbors are naturally deep enough to accommodate them and where this is not possible terminals may be built offshore. Either way, supership ports pose a considerable environmental hazard that must be a significant factor in deciding where or whether to build a facility.

Suggested Readings

In addition to the Soros Associates study discussed in the text, the author recommends the following reports for those interested in getting immersed in the subject of superports: *U.S. Deepwater Port Study*, prepared by Nathan Associates for the U.S. Army Corps of Engineers, August 1972; *Foreign Deep Water Developments*, prepared by Arthur D. Little, Inc., for the Corps of Engineers, December 1971; *Preliminary Analysis of the Ecological Aspects of Deep Port Creation and Supership Operation*, prepared by the University of Maryland for the Corps of Engineers, October 1971; and *Economics of Deepwater Terminals*, U.S. Maritime Administration, U.S. Department of Commerce, 1972.

Trend of Affairs

Trends This Month

GENETICS

Genetic Manipulation A Fresh Problem . . .

At its Washington meeting last winter, the American Association for the Advancement of Science spent many of its sessions talking about human values and the effects of technology. Speakers, panelists, and listeners spent many hours in forming and rephrasing questions, in talking about the shapes of familiar problems. But fresh questions and opinions did come at one session, an all-day one on "Genetics, Man, and Society"; for these dilemmas are new. Only in the last few years has any sort of genetic management, except for selective marrying, been possible, and so as people talk about the problems, they can still find new holes surfaces and entries. The session showed that many people do not understand just what sorts of genetic manipulation are actually possible and what might be within reach someday. And many people are frightened, both rationally and irrationally, about what society might do with the new techniques.

All we have now to manage our inheriting is our understanding of the Mendelian laws of inheritance, the knowledge that some diseases are passed on from parent to child in accord with these laws, and the ability to test an unborn child for some 30 to 40 of these diseases.

This test is done by drawing off a sample of amniotic fluid early on in a pregnancy and examining the cells the child has sloughed into it for certain chromosomal abnormalities, Downs syndrome or mongolism for one, and for some disorders of one or more genes, the Duchenne type of muscular dystrophy, for example, or Tay-Sachs disease, or Lesch-Nyhan syndrome. There is no cure for most of these, so the parents and the stricken child face inestimable pain—and expense. (Often no outside help in either care or money is proffered, and the whole family warps to the child's needs.)

The test, called amniocentesis, is given in programs of genetic counseling at several medical centers. Counselors explain how a genetic disease is inherited, what disease a particular couple may be carrying, what the chances are that their child will have it, and, if amniocentesis is appropriate, what the process is and what it will tell them. The centers conscientiously avoid recommendations—to have children or not, or to abort or not, for that is the end amniocentesis points to if the child is found defective.

The panelists generally found amniocentesis a blessing, rather than much of a danger to freedom. As of six months ago, just over 1,500 tests had been made in North America; the results led to 110 abortions and 1,416 births of healthy children, who, said Michael Kaback, professor of pediatrics at U.C.L.A., might not have otherwise been born. This test lets parents of one diseased child try again, knowing that they can find out and abort another or find out and bear a healthy one.

A Few Techniques Now; More for "Someday"

Our next tool will be a scope by which we can "see" the fetus, Dr. Kaback said. It is now being used experimentally in animals, and he thinks it will be used in humans within a few years. The device sounds tantalizing: its details are still secret. But, Dr. Kaback said, it is less than 2 mm. in diameter, it will be inserted into the uterus as the amniotic needle now is—both devices might be in one unit, and it will describe the fetus with such precision that one can count the fingernails. It will need to be inserted in only one place to see the whole child, and it will warn of abnormalities we cannot know of by testing genes—unclosed spines and missing limbs, for example. "The technical hurdles, such as getting the scope small enough and getting a fine enough resolution in its vision, have been overcome," Dr. Kaback said. "We still have

to find out what the reaction of the uterus will be; there are some other problems that require more testing before we can use it in humans." (Already, the fetus can be scanned for gross abnormalities by an ultrasound device outside the mother's body.)

One more test of the fetus would also be useful—a way of drawing a sample of the fetal blood, for that would give away other diseases such as sickle cell anemia.

These few are the techniques we have or will have soon; the wilder ones such as fertilizing an egg outside of the womb and then implanting it to be borne as a normal fetus, or cloning (the generation of genetically identical individuals from one cell), or inserting a corrective bit of genetic material into a cell by a virus; all these are too expensive, too chancey, too plainly impractical to worry about for some considerable time. The cost of saving a premature baby, for example, indicates the unaffordable cost of tending a cloned off-spring; the odds of getting a virus to carry the right piece of D.N.A. into a cell by the easiest technique are one in 100,000—and how many of a sick person's cells must be altered to cure him? How do you correct all of his sperm cells or eggs, so the disease is not given his child? Even if you manage to correct a defect, in a parent or his child, how do you know you have not in doing so upset some balance and brought out another problem?

Of these far-off techniques, in vitro fertilization seems the closest. Eggs from rabbits, cats, guinea pigs, and a few other animals have been removed from an animal's ovaries, and fertilized. Fertilized rabbit eggs have then been implanted into living mothers and some have produced live young—some 22.6 per cent of the eggs removed eventually lead to births. That is the best record—and the whole procedure is successful with even fewer animals than is in vitro fertilization. It too will not be used in humans for many years. —*J.K.*

. . . . Brings Fears And Questions . . . .

Even if the possibilities of manipulation are limited, the questions and fears are not. No answers came from the session, no recommendations, but the talk was lively and emotional. Because many possibilities were up for discussion, and many people were involved, the talk was also broad in range. Among the statements and questions:

☐ If a couple finds that its child will have an incurable genetic disease, and still chooses to have it, has society the right to insist that the couple bear the expense of the child's care? Garrett Hardin, of the University of California-Santa Barbara, answered his own question, "Yes." One panelist foresaw that insurance policies covering maternity would, in cases of risk, insist on genetic counseling and perhaps amniocentesis at the insurer's expense; the insurer would pay for an abortion, were one indicated, or be relieved of the cost of caring for a diseased child. Those costs presently range from tens to hundreds of thousands of dollars.

☐ From Stephen Breyer, of Harvard Law School: in choosing traits for their children, should that become possible, parents might make decisions that make sense individually—to have a child 10 per cent brighter than average, or a blond, blue-eyed male—but would be disastrous if everyone made the same choice. "Like the one guy in the third row at a Bruins game who stands up to see better," he said; "pretty soon everybody has to, and nobody can see any better. And they're all uncomfortable."

☐ The courts enjoy more public trust than any other agency which addresses behavioral questions, and some recourse to them must be available to protect individuals from decisions about child-bearing, for no administrator can be unbiased and constantly sensible.

☐ Good intentions are no guarantee that evil will not happen.

☐ Said Robert Cooke, pediatrician-in-chief at Johns-Hopkins: what is way-out technically is also way-out economically. And Mr. Breyer: if a nation so wanted, it could already have bred selectively for a master race or race of slaves, for we already have enough knowledge to do that. "I worry more that sensationalism and fear will cause a rigidity in people's minds that will cut out techniques that will yield good."

☐ We fear that governments may make abortion mandatory if amniocentesis shows a defective fetus—or even if tests show that its parents could produce one—yet, said Thomas Schelling, a Harvard economist, governments now make it mandatory not to abort a fetus. What is the difference? One can argue that laws requiring abortions might help parents cope with a defective unborn child, he continued, for the weight of the law can help them accept that choice and explain it to others such as the child's grandparents or siblings.

☐ Will we, if we can choose some of the characteristics of our children, lose our tolerance, such as it is, of imperfections and differences?

☐ Asked Roger Shinn, the Reinhold Neibuhr Professor of Social Ethics at Union Theological Seminary: how can a society that has not learned how to stop its president from such as the bombing of North Vietnam possibly know how to tell a woman if she can have a child?

☐ A member of the audience told of a man who lost his job as a truck driver when his medical report indicated he carried the trait for sickle-cell anemia. (He had one of the two recessive genes necessary to produce the disease.) How could scientists keep on studying these technologies when such harm was coming from them? she asked. "You must remember what your outrage is against," a panelist told her. "I took a plane here but that does not mean I support the bombing of North Vietnam." The knowledge and how it is used are separate, was his point.

☐ Asked a second panelist: Is it proper to make available any genetic alternatives without providing controls on the ways they will be used?

☐ When we consider, another said, the effects of carrying a damaging gene such as the one for sickle cell—not of having the disease—we might remember that many genetic diseases have not been described yet, and all of us carry from four to ten harmful genes. They are recessive genes, as the one for sickle cell disease is, so they are overriden in most of us by a normal gene. Only when two parents carry a recessive harmful gene is there a likelihood (of 25 per cent) that any child will have the disease.

☐ Ignorance is a big problem, for the understanding and evaluation of genetic risks is subtle and sophisticated. It is also laden with emotion, for society in general and especially for individual families. Genetic counseling centers carefully explain the nature of the diseases their clients may carry and of their transmissal, but, because of distance or expense or other reasons, many who need guidance do not get it. Many look for help to physicians who cannot give it and stop there. It is probably becoming essential that genetics is thoroughly taught in high school.

☐ The Congress also needs education, as do all legislators. Its "institutional memory" is slender, Herbert Jasper, staff aide to Senator Walter Mondale, said. Sen. Mondale has introduced a bill to set up a two-year commission to study questions like those raised at the session. Perhaps eight or ten senators know more about genetic manipulation and its problems than the average well-informed layman Mr. Jasper said; yet they must guide its use.

☐ Daniel Singer again: The difficulties we have with genetic discoveries will come not from obvious evils but from ambiguous choices between several goods and several desires. He believes common decency will prevail.—*J.K.*

. . . . And No Small Helping of Joy

Michael Kaback described the life of a child born with Tay-Sachs disease, and his words gave another definition to genetic manipulation (*see above*). Tay-Sachs is a degenerative disorder of the nervous system. There is no cure.

This child, born several years ago, was bright looking and smiling, contented, for his first half year. But in the next few months his parents realized he was slowing down, he was not beginning to crawl and walk. By the time he was one, his parents knew of his disease, and for the next three years could only watch him die. He lived his last two years in a hospital. Before he died, his limbs were but spindles on which he could not lift himself. Feeling the horror of their son's life, and knowing the odds were one in four of having another blighted child, the parents decided sadly against trying again. Until they learned of amniocentesis.

And now, after a normal pregnancy, through most of which the mother serenely knew her child was normal, they have a year-old son. And this, Dr. Kaback said, is what amniocentesis and genetic testing is all about—letting frightened parents try again, knowing that if the child has an incurable genetic disease it need not be born—knowing they can ensure a healthy child.—*J.K.*

FAR OUT

" . . . There Will Never Be Another"

Of all the sentimental outpourings on the end of the Apollo program, one had special meaning in Cambridge:

"This is a moment the like of which there will never be another," said Charles S. Draper, holding aloft his champagne toast to some 300 colleagues of the Draper Laboratory after their guidance system had brought the last of the Apollo astronauts home from the moon.

There had been, he recalled, amply justified early skepticism: could the difficult technical problem of the onboard guidance, navigation and control systems for command and lunar modules in fact be solved?

"All I can say now," Dr. Draper said, "is by all the gods you did it."

Even when the Apollo 17 lunar module Challenger had landed at its Taurus-Littrow target on December 11 there was praise for the guidance system. "Perfectly nominal." "One of the best platforms we've ever had." "Beautiful!"—these were the expressions of the Draper Laboratory's engineers stationed at Houston during the flight.

"By all the gods you did it!" said Charles S. Draper to his colleagues in the Laboratory which bears his name on the afternoon of the successful return of the last Apollo lunar mission. Like all U.S. manned space programs before it, the Apollo series depended upon inertial guidance developed at the Draper Laboratories. It was Dr. Draper himself—who has been a member of the M.I.T. faculty since 1929—who first conceived of preserving the coordinates of moving objects with the inertia of gyroscopic devices, and it was he who founded M.I.T.'s Instrumentation Laboratory to teach the concept to undergraduate and graduate students and develop equipment based on it for defense, commercial, and space-related missions. (Photo: Marc PoKempner)

Although, as he noted, the flight still had to be returned safely to Earth, David G. Hoag, Apollo Program Director for the Draper Laboratory, added his praise on that day: "It is not premature to believe that historians will one day look back at Apollo and say that man's first ventures away from his own planet were made possible in no small way by Draper people."

More than a week later, on December 19, Mr. Hoag's judgment was amply confirmed. At drogue deployment, the display and keyboard portion of the Apollo 17 on-board inertial navigation system told the astronauts that they were only 1.2 nautical miles short of the programmed target and that they were exactly on track. "Write it down," said one Draper Laboratory worker, "this is the best system we ever had."

The guidance system easily accommodated the change in the altitude chosen for the beginning of Challenger's descent from 65,000 ft., 10,000 ft. higher than first planned.

When the landing area turned out to be strewn with more boulders and craters than had been expected from radar mapping, Commander Gene Cernan used his hand controller to select the final touchdown point. The lunar module settled only 250 yds. east and 100 yds. south of the landing target put into the guidance computer by Draper Laboratory programmers months before.—*J.M.*

Congratulations
From Richard M. Nixon to Jerome B. Weisner, President of M.I.T.:

"Few events in the history of exploration have been as dramatic as the journey of Americans to the moon. But even as we take pride in the astronauts themselves, we also join them in recognizing that these greatest of scientific explorations were made possible by the thousands of other men and women whose energy, devotion and considerable genius have brought this Nation to a position of pre-eminence in space.

"The knowledge gained through the Institute's contributions to the Apollo program will benefit humanity for centuries to come. I extend to you my congratulations and the thanks of the American people for a job well done."

Looking at Mercury

The surface of Mercury—the hot, innermost planet of our solar system—is probably like that of the moon, covered with a soil made up of glasses rich in iron and titanium. Since such glasses are created on the moon by meteorite impacts, a further hypothesis is that the surface of Mercury will turn out to be pock-marked much as is the moon.

These results are reported by Thomas B. McCord, Head of M.I.T.'s Planetary Astronomy Laboratory, and John B. Adams of the West Indies Laboratory of Fairleigh Dickinson University (Science, *Vol. 178, pp. 745-46*). They are the result of studies of the light reflected from Mercury made in 1969 and 1972 at two locations—the Cerro Tololo Interamerican Observatory in Chile and Kitt Peak National Observatory, Arizona.

Analysis shows that the spectrum of light reflected by Mercury "is quite similar to that for the lunar upland and mare material," says the scientists' report in *Science*. If the moon were viewed as a whole, as Mercury necessarily was, these would be the predominant characteristics. So Professors McCord and Adams propose "a similarity in the mineralogy and composition of their soils." This conclusion is further supported, they say, by the fact that Mercury and the moon have similarly low albedo—general reflectivity.

The spectrum of light reflected from Mercury also suggests the existence there of some crystalline pyroxenes, a frequent constituent of igneous rocks, and some silicate mineral as yet unidentified.—*J.M.*

Mars: More Like Earth After All?

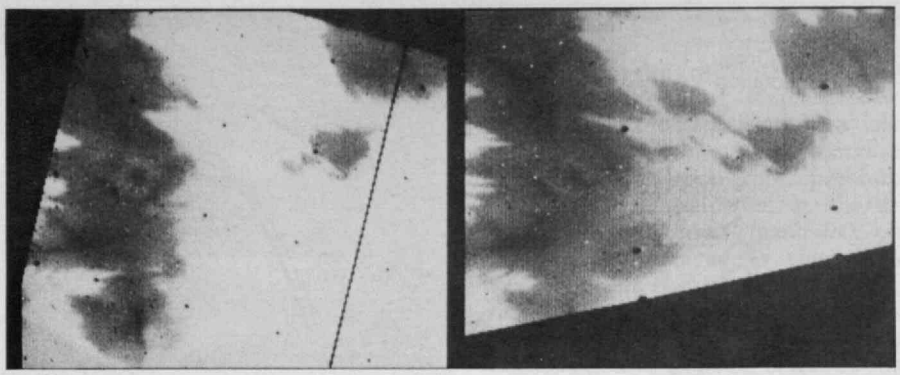
For decades astronomers watched Mars with special interest: its changing "canals," its recurring polar icecaps, its size and its location in the solar system all combined to suggest that it might in fact harbor life in the image of that on Earth.

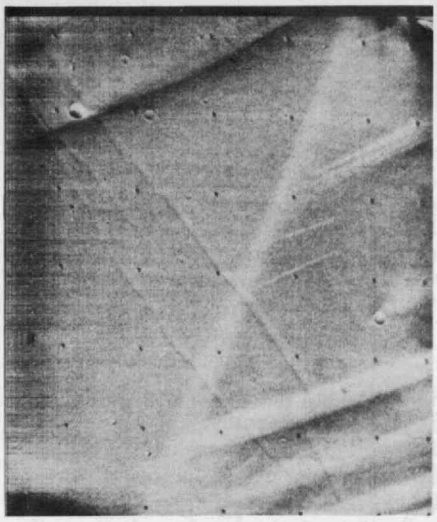
Then came disillusionment. Photography from the earliest space probes confirmed none of these romantic yearnings, and Mars emerged as a cold, moon-like planet whose surface seemed to reveal only countless impacts with cosmic bits.

The remarkable high-resolution photography and instrumentation of Mariner 9 has changed our view again: Mars may not harbor life as we know it on Earth, but it is far from a dead planet on which evolution has run its course.

Indeed, to the sharp eye of Harold Masursky and his colleagues at the U.S. Geological Survey in Flagstaff, Ariz., the surface of Mars displays works of most of the basic geological phenomena which have shaped Earth to its present fertility.

Water and carbon dioxide together make up the polar ice caps of Mars, though it is not yet possible to say how much water that they contain. Water has clearly also been a factor—along with wind and volcanism—in shaping the Martian topography as it exists today; indeed, says Dr. Masursky, it's "comforting" to find features on Mars which strongly suggest erosion by water flowing to a lower elevation. The Martian poles are lower than the rest of the planet, suggesting to Dr. Masursky subsidence from the weight of some past polar cap. Some of the topographic features of Mars are similar to those associated with permafrost on Earth.





Only a few weeks passed between the times these two pictures above were taken by Mariner 9: what you see is a pattern made in dust by the Martian winds. The photograph at the left, another from Mariner 9, shows another pattern made by wind-blown dust: rigidly straight and parallel lines all coming at the same angle from another rigidly straight line (one of a similarly parallel series). They were made, astronomers suppose, by winds blowing first in one direction and then in another.

Volcanism has been a larger factor than water in shaping the Martian topography recorded by Mariner 9, Dr. Masursky believes. There is a great rift valley not unlike that in Africa; there is extensive smaller faulting—thought to be recent because it is largely unaffected by erosion; there are channels through which lava seems to have flowed; and there are great volcanic mountains in an alignment which suggests to Dr. Masursky the existence of continental plates and "incipient continental drift" of a kind which geologists now know has shaped Earth's surface. (Carl Sagan, a Martian explorer from Cornell University, hopes that some of these features might reflect the work of water instead. See Victor McElheny's column for June, 1972.)

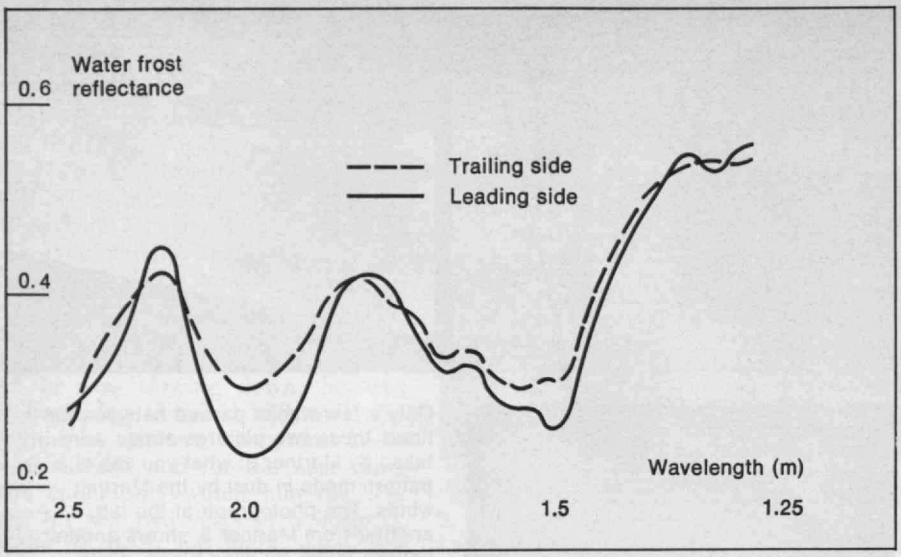
But wind is the most constant force affecting the Martian surface, and it works in dust. Layers not unlike sedimentary deposits are revealed by Mariner 9 photographs of the Martian north pole—dust carried from equatorial to polar regions by periodic dust storms such as that which greeted Mariner 9 upon its arrival in Martian orbit. The changing "colors" of Mars—the "canals" of the earlier, romantic visions—turn out to be the work of wind. When the dust of the great storm finally settled the dark "canals" were not to be seen; now they are reappearing as the surface material is reworked by winds; a similar changing surface is familiar to geologists who have studied a sandy desert in Peru.

Its spectrum suggests that the dust on the Martian surface has a high quartz content, says Professor C. Leovy of the Department of Atmospheric Sciences at the University of Washington, who shared with Dr. Masursky the report of Mariner 9 results to the American Association for the Advancement of Science this winter.

How strong are the winds that sculpt the surface of Mars in dust—and occasionally raise the immense storms such as that which greeted Mariner 9?

In the zone of greatest temperature gradients, winds of 50 to 60 m./sec. (something over 100 m.p.h.) may be common on Mars. These are strong enough to keep dust constantly in the Martian atmosphere, where it serves to "dramatically" warm the atmosphere and further increase its instability, thinks Dr. Leovy. Thus the winds and dust tend to maintain themselves through a positive feedback of energy.

The solar energy input to the Martian atmosphere is greatest when that planet is closest to the sun. Only when that and the Martian solstice occur together, when there is ample energy and a maximum energy imbalance between Martian hemispheres, do the great dust storms appear on Mars.



Light reflected from Jupiter's moon Ganymede shows the precise spectral characteristics of water ice, and M.I.T. astronomers suggest that perhaps half of that moon's surface is covered. In addition, their spectral data show an intensity difference which indicates a 20 per cent greater frost cover on Ganymede's leading side than on its trailing one, and this agrees with observations that the leading side of Ganymede is somewhat brighter than its trailing side.

All this suggests to Dr. Leovy that Mars has in fact a "weather" of winds, clouds, and dust born in the same kind of thermodynamically driven turbulence that is familiar to us on Earth. But he admits that the details still involved "a lot of speculation."—*J.M.*

Distant Water, Hydrogen, and Life?

If Mars—though more like Earth than some astronomers believed a decade ago—harbors no life as we now know it (*see above*), what of the rest of the solar system?

Suddenly the answer to that question depends less on Venus, the other Earth-sized planet which is our near-neighbor, than on several obscure candidates circling Jupiter and Saturn, the largest distant planets.

Carl Sagan, Professor of Astronomy at Cornell University, told John Noble Wilford of the *New York Times* this winter that Titan, the largest of Saturn's ten moons, "may be a miniature of what the earth was like in its early history."

And data from three astronomers—Carl B. Pilcher and Professor Thomas B. McCord of M.I.T.'s Planetary Astronomy Laboratory and Stephen T. Ridgway of the Kitt Peak National Observatory and the State University of New York at Stony Brook—demonstrate "conclusively" that water frost exists on the surface of at least two—and possibly four—of Jupiter's moons.

Dr. Sagan reports that Titan is clearly warmer than it could be if solar radiation affected it only as it affects Earth. Instead, he proposes that Titan is surrounded by an atmosphere of molecular hydrogen which causes a "greenhouse" effect, trapping and gradually collecting—instead of radiating—the heat which comes to it from the sun.

Small quantities of molecular hydrogen have in fact been detected by measuring the sunlight reflected from Titan, but most of the light from that moon appears to be reflected from clouds, not from a solid surface. Professor Sagan postulates that beneath the clouds is a molecular hydrogen atmosphere with pools of hot methane from which could come both hydrogen and the organics which are necessary for the creation of life as we know it.

Drs. Pilchard, McCord, and Ridgway present the first quantitative confirmation of water on Jupiter's moons (Science, *Vol. 178, pp. 1087-89*). Analysis of the light reflected from them suggests that water ice may cover 75 per cent of the surface of the moon called Europa and perhaps half of the surface of the moon named Ganymede.

Light reflected from two other moons of Jupiter reveals at least traces of water ice: perhaps 5 to 15 per cent of the surface of Callisto is covered, and the results for Jupiter's first moon—Io—are inconclusive.

Water ice on the satellites of Jupiter was not unexpected; indeed, it has been identified in the rings of Saturn. Nor does its presence imply the presence of life. But the mass of Ganymede may be large enough to hold an atmosphere, and under those conditions the presence of water could be of considerable interest.—*J.M.*

Apollo's Target: A Lava-Filled Hole

Apollo 17's landing site was chosen partly because there seemed to be a lava flow under the valley, between two large mountains in Taurus Littrow, in which the lunar lander would sit. Information about the lava's gravity and that of the features around it ought to give useful clues to the moon's geology.

A gravimeter on the lunar rover quickly confirmed this expectation. Apollo 17's landing site was in fact atop a block of lava at least 1.5 km. thick, and some geologists then suggested a connection between this lava body and a mascon already known to be west of the landing site.

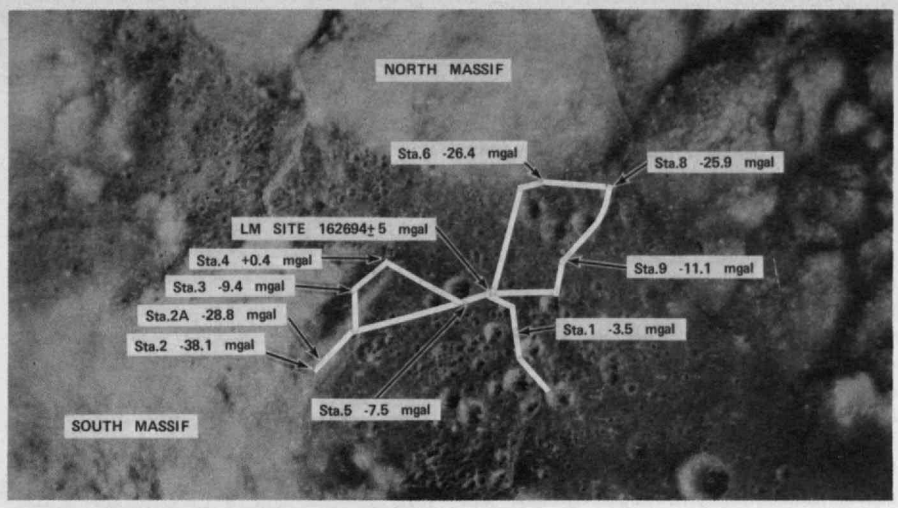
It is already clear to Sheldon W. Buck of the Charles Stark Draper Laboratory, where the gravimeter experiment was designed and the equipment built, that the lunar lander sat over what had been "a very deep valley with extraordinarily shear sides before it filled with a lava flow." The whole is now, of course, covered with a layer of lighter, coarse-grained brecchia from which the surrounding mountains are formed.

"What was particularly impressive," says Mr. Buck, "was the rapid fall-off of gravity values as the astronauts neared the base of the South Massif. This is where we could see the interface between the denser basaltic material in the lava bed and the lighter material that makes up the Massif itself."

Further analysis of the gravimeter results will be reported by Manik Talwani of the Lamont-Doherty Geophysical Laboratories of Columbia University and George Thompson of Stanford University, principal investigator and co-investigator, respectively, for the experiment.

The gravimeter was a vibrating-spring accelerometer, measuring the vibration of a mass suspended freely between two springs. A change in gravity affected the vibration, and the equipment could in this way sense gravity differences.

In all, Apollo 17 astronauts obtained 21 different readings from the 28-lb. device, which "worked perfectly all three evenings," Mr. Buck notes with some pride. The gravimeter was accurate enough to measure differences of as little as 0.0003 gal. A gal is the gravitational force required to accelerate 1 g. of mass 1 cm./sec.; the earth's gravitational field is about 980 gals at sea level, and the reading at the site near the lunar lander where the Apollo 17 Lunar Surface Experiments Package was deployed was 162.6992 gals.—*J.M.*



Gravity differences surrounding the Apollo 17 lunar landing site prove that the site was in fact above a surprisingly sheer valley filled with lava. A gravimeter designed and built at the Charles Stark Draper Laboratories in Cambridge recorded the gravity at the landing site as 162.694 gals. (1 gal is the gravitational force required to accelerate 1 g. of mass 1 cm./sec.; earth's gravitational field is some 980 gal.) When the astronauts made their closest approach to the South Massif the moon's gravitational field was 38 milligals less; the sharp changes between stations 3 and 2A and between stations 8 and 9 approaching the East Massif suggest a deep body of lava with steep sides.

ENVIRONMENTAL LAW

Mission Possible

The National Environmental Policy Act, during three years of boisterous life in the courts, has made it legally possible to coerce federal agencies into taking their public service missions more seriously. And some of them—grudgingly, at times vindictively—seem to be doing so.

Basically what it comes to is, an agency must comply or its project dies. First, of course, an agency must be caught not complying with N.E.P.A.'s requirement for full-disclosure environmental impact statements. Once that happens, the law is effective.

Harold P. Green of the National Law Center at George Washington University told an overflow crowd at last December's Washington meeting of the American Association for the Advancement of Science that more than 200 cases involving failure of federal agencies to comply fully with N.E.P.A. have been adjudicated in federal courts. As a result many projects have been delayed—the trans-Alaska pipeline (see story below) and Continental Shelf drilling leases—and a few have been sorely wounded if not killed by actions that never quite made it to the courtroom—the cross-Florida barge canal and the supersonic transport. Hundreds of new cases are on court dockets or under preparation by a variety of plaintiffs ranging from national conservation organizations to ad hoc citizen groups.

Many regard N.E.P.A. as a delaying action, the agencies ultimately getting what they want. While this is probably true for most projects, the act has in fact forced the agencies to think in terms that had not occurred to them in the past and has opened up part of the federal decision-making process. And the courts have ruled that agencies may not arbitrarily disregard the intent of the Act.

In Mr. Green's view, the general reaction of the courts to this new kind of litigation has been that the federal agencies are competent to analyze the environmental impacts of their proposed projects and that they must bear the responsibility for making the basic project decisions. The courts have no desire to second-guess these presumably competent decisions. By the same token, however, the agencies are required under the law to produce adequate environmental impact statements. Therefore, until a court is satisfied that the adequacy requirement is met, a project under litigation must stay in its cocoon.

"Full disclosure" may be the most significant interpretation of N.E.P.A. To Mr. Green this suggests that not only must the agencies inform and educate the public but also that the public response should inform and educate the agencies. In analyzing court decisions Mr. Green found that the environmental impact statement provides a means for the public to hold decision-makers accountable. Projects must be fully and candidly discussed; all possible environmental consequences included; all responsible dissenting viewpoints referred to; and all reasonable alternatives considered, even if an alternative falls outside of an agency's mission. The courts have also ruled that agencies may not cite existing standards as a reason not to do better. And, at least as important as any other moral or practical consideration, the courts have made public participation in the decision-making process mandatory on the part of the agencies engaged in projects under N.E.P.A.'s jurisdiction.

Another participant, Edward L. Strohbehn, Jr., of the Natural Resources Defense Council, observed that the legal decisions favoring environmental protection and citizen participation "were generally made by conservative judges."

Although Mr. Green was quite happy with the N.E.P.A. successes in court, he caught the feeling of most of the participants and audience when he regretted that "the Congress *had to* enact a law like N.E.P.A. to get federal agencies to do what they are supposed to do. It is also regrettable that litigation has been necessary."

Nevertheless, he would extend that litigation to test whether acts of Congress are valid without environmental impact statements.—*R.S.*

Federal Agencies Account to Us

It took the Department of the Interior about 175 man-years to produce an environmental impact statement covering the proposed trans-Alaska oil pipeline. As of January, nearly a year after the complex statement was pulled together, it is still in litigation, challenged for its alleged failure to comply with the National Environmental Policy Act (N.E.P.A.). A final decision on construction of the pipeline will wait until the case finally emerges from the chambers.

N.E.P.A. has been in existence a little over three years and has generated nearly 4000 environmental impact statements; those who evaluated it at the A.A.A.S. symposium (*see above story*) felt that its effects were generally good ones.

"Experience has shown that the mechanism chosen to meet [N.E.P.A.'s] goals was insidiously effective," said Daniel A. Dreyfus of the Senate Committee on Interior and Insular Affairs. His interpretation of the Act's goals was that it ensure that environmental consciousness penetrate into the remote recesses of the federal administration and influence the myriad decisions made there. "I would venture to guess," he guessed, "that *no* federal statute of modern times has been read by a greater proportion of officials than has N.E.P.A."

Frank Potter, a former aide to and substitute speaker for Rep. John D. Dingell (D.—Mich.), declared pithily that "the value and utility of the N.E.P.A. varies directly with the pain and suffering it causes the bureaucracy."

The Bureau of Land Management, which manages about 20 per cent of the land in the United States and all of the U.S. Continental Shelf, uses the environmental impact statement as a management tool, said Bureau Director Burton W. Silcock.

The Bureau has put together a division—including a natural resource specialist, a sociologist, an ecologist, and a landscape architect—to develop guidelines for complying with N.E.P.A. "It has meant," said Mr. Silcock, "that we have had to shift our priorities from meeting public demands for resources and services to greater emphasis on inventory, analysis, and planning."

Since N.E.P.A. was enacted the Corps of Engineers has acrobatically reversed its image from environmental villain to champion. "Contact with the public is maintained throughout the study process," the Corps' Robert R. Werner said, "as we investigate the [local] problems . . . and determine the parameters of a broad range of alternatives. . . . The alternatives include the option of no action at all."

In response to the Rivers and Harbors Act of 1970 the Corps also developed guidelines for assessing social, economic, and environmental effects of civil works projects. This combined assessment requires at least three formal public meetings as each part of the study progresses, and helps considerably in preparing full-disclosure environmental impact statements.

While the Corps of Engineers has been generally applauded for its new open, or as Colonel Werner calls it, "fishbowl," approach to public works, some oldtime adversaries of the Corps and other skeptics are apprehensive. For one, well-known engineer Arthur E. Morgan (the author of *Dams and Other Disasters*, reviewed in the May, 1972, *Technology Review*), who was not at the symposium, is concerned that not only is the fox in the chicken coop, but that it is camouflaged in chicken feathers. Dr. Morgan fears that by moving into the areas in which it not long ago exhibited its greatest insensitivity and shortsightedness the Corps may be co-opting the conservation movement.

The federal agencies, at least at the symposium, seemed to be saying that they are complying with the Act and indeed they are benefitting in doing it. On the other hand, environmentalists and representatives of the federal legislature at the symposium felt that in many cases the agencies have been slipshod, self-seeking, uncooperative, and insensitive.

Torpedoing with Misuse?

For example, Mr. Potter said the Department of Transportation (which was not there to protect itself) blames N.E.P.A. for impeding construction of the interstate highway system. The Department has written about 60 per cent of the impact statements that have reached the President's Council on Environmental Quality. One can speculate on whether such massive overproduction of paperwork by one division of the Executive branch is evidence of simple inefficiency, misguided devotion to the environmental cause, bureaucratic masochism, or spitefulness, or some unknowable combination of factors. This outpouring of what Mr. Potter regards as generally superficial statements covering minor as well as major sections of road has provoked many time-consuming court challenges.

"What the highway statements should and usually do not include," he continued, "is what will happen to people and places served by the highways."

The Atomic Energy Commission has sometimes overreacted to the N.E.P.A. requirement for impact statements, according to Harold P. Green of the National Law Center at George Washington University. In discussing feasible alternatives for a nuclear power plant the A.E.C. mentioned the following possibilities: not operating the plant, physically picking it up and moving it to a more suitable site, or converting it to coal or oil. Commented Mr. Green: "Page after page of calculations on these ludicrous alternatives were included in the impact statement."

The Council on Environmental Quality, with only 30 professionals on its staff, manages to read every environmental impact statement and acts on those they consider significant or controversial. Although freely admitting to not yet knowing what a good statement is, C.E.Q.'s Steven D. Jellinek wants the federal agencies to stop viewing N.E.P.A. "as an obstacle rather than as an opportunity . . . Too many agencies bridle at the idea of public participation in their decision-making, [and this is why] to date we have had citizen action rather than citizen participation."

Mr. Jellinek said the Council is trying to help the agencies produce better impact statements, has advised them to provide interested citizens with "early warnings" that statements are being prepared, and is starting a program to help agencies perform more complex assessments of social and economic effects of their projects and programs.

N.E.P.A. is having some positive effects on government operations, some of which perhaps it was not specifically intended to have. It is nudging the federal establishment toward government by policy and away from government by mission. It is providing a systematic way of dealing with the problem of overlapping agency functions and is encouraging interdisciplinary analysis of problems. Mr. Jellinek feels that N.E.P.A. has opened up government decision-making for the first time; and for the first time accountability is a part of the federal process and that right of access is enforceable by citizen suit.—*R.S.*

Progress Report on Evaluating Impacts

We are gathering a set of ways to evaluate the environmental impacts of new projects or new plants, and the American Association for the Advancement of Science devoted a symposium to them at its annual meeting. The ways we have, it became clear, are still pedestrian, are fairly thorough, and they try to involve subjective and objective questions in one decision. Pedestrian they will be, and thorough they should be. But we must have in time a way of using our subjective judgments in our evaluations—for now, we can only hope that an agency head or a judge will be imaginative, generous, and fair.

One way of finding a plant's impact is to trace along a diagram of all of its processes and note any material it puts into air or water or any place at which it might accidently release one. The next step, said Charles Coutant from Oak Ridge Laboratories who described this mechanical process to the session, is to discover what effects any of those materials would have—this is the harder part. For example, discharges behave differently in different weather. A plume of warm water discharged into a lake by a power plant may surface and evaporate in the summer, yet in the winter sink and diffuse through the water because the density of the lake has changed. If the bottom water rises even one degree, fish eggs lain to await the spring can hatch in the winter. We must monitor the behavior of a plant's discharges, once it is built, and of their effects.

Once we have some idea of a project's impact, we should compare it with the effects of other types of projects, and with the effects of none.

Mitchell Morse of the University of California-Berkeley especially asked, what are the effects of not doing something? What of the recreational needs of Los Angelenos if they cannot ski at Mineral King? If access to the Pacific

Graphics from the United States Government Printing Office? Yes indeed—to adorn a thoughtful and lively and useful guide to getting involved as a citizen in environmental protection. The Superintendent of Documents (U.S. Government Printing Office, Washington, D.C. 20402) sells it for $.55.

coastal lands is restricted, will the Corps of Engineers build artificial lakes in Watts? The demand for mountains and beaches will remain, after we make the choice not to develop them.

Value judgments are implicit in what the impact statement includes, Mr. Morse continued. The statement must say who will bear the costs of building or of not building. And what is expensive to one man will not be to another. He described a small, impoverished town in Washington: an aluminum company wanted to build a plant there, and the townspeople, desperately in need of jobs, welcomed it. But wealthier people, residents of Seattle, owned second homes in that remote area, and they prevented its construction on environmental grounds. The local year-rounders paid for the tranquillity of those vacation homes.

Some evaluators try to put all of the impacts into numbers. These schemes are complicated—one matrix, developed last spring, has 6000 points of decision and entry. Many of those points are interrelated, and the networks "make for a hell of a printout," Jens Sorenson, Mr. Morse's partner, told the audience. And no matter how precise the numbers look, somebody assigns them arbitrarily to the social and aesthetic impacts.

No soul has said how else the judgments, finally, can be made except by an agency administrator—one hopes a fair and imaginative one, better-informed for the impact statement—for there will be many more decisions than voters and legislators can make. We must continue to have recourse to the courts, to decide whether those numbers or weightings are fair to those involved, or even who are those involved. (The suggestion has been made, not at this meeting, that we ought to have a set of courts to deal only with environmental conflicts.)

The session left one sensing that the filing of environmental impact statements and the monitoring and the discussing they involve will be tedious and repetitious and probably we will become lax and tend to slight them. Nonetheless, we have made it a national policy to look into such matters and we have kept it a national policy through one strong challenge—when, last spring, the White House tried to moderate the section of the National Environmental Protection Act that required environmental impact statements.—*J.K.*

E.P.A. Wants YOU!

The Environmental Protection Agency has published a nice, short, concrete, lively, and useful little handbook on how your citizen's group can and should help make, force, and enforce decisions about our environment.

Among the things the E.P.A. advises you to do:

☐ Get to know the E.P.A. staff in the regional office nearest you. There are ten across the country.

☐ Know what your'e talking about: "To be effective a citizen's organization must be credible. . . . It must not accept as gospel whatever uninformed individuals, no matter how well-meaning, might say."

☐ Pick your targets carefully: "To be effective, citizen groups must convert [their] initial "anti" motivation into well-conceived, positive action programs. . . . If the automobile is the prime villian, . . . do you stage a demonstration and bury a car? . . . [Or] do you try to have your state initiate and enforce an automobile emissions control inspection program?" Water conservation, the booklet goes on, "begins not with putting a brick or rock in the toilet tank, but with keeping water as clean as possible in the first place by controlling industrial or municipal sewage discharges . . . so the water can be used and reused over and over again."

☐ Go forth and lobby: "Lobbying is as American as apple pie." And, the guide says, "A wealth of literature is available on how, and how not, to lobby. No matter how experienced your group might be. . . , you will find it worthwhile to review some of the available publications, especially *The Sierra Club Political Handbook*, available from the Sierra Club, 1050 Mills Tower, San Francisco, Calif. 94104."

☐ Be useful to the local press: Take a managing editor to lunch, and tell him about your organization. Find out his requirements, and send out press releases that fit them. "Be sure of your facts. If you mislead the press, you can destroy your credibility and public acceptance."

☐ Speak at public hearings: write up and duplicate the statement you will deliver. Copies go to the press and to each of the people taking testimony. Again, protect your credibility. And try to have "many supporters" at the hearing: "Some call this 'packing a hearing.' Others call it 'showing strength and support.' Numbers reinforce your stand."

☐ E.P.A., the booklet says, tries to comply with both the letter and the spirit of the Freedom of Information Act, so ask the agency for the information it has on impact statements, on what pollution control agencies are doing, on pollution control techniques. Under that act, "all Federal agencies must make available any record or document properly requested by the public. If a Federal agency does not do so, the person requesting the information has the right to bring suit in Federal court to compel compliance."

☐ Go to court if need be: "Recent laws give citizens new and more potent legal rights. . . . The possibility of a citizen suit can often stimulate government at all levels as well as polluters to comply with environmental laws and regulations."

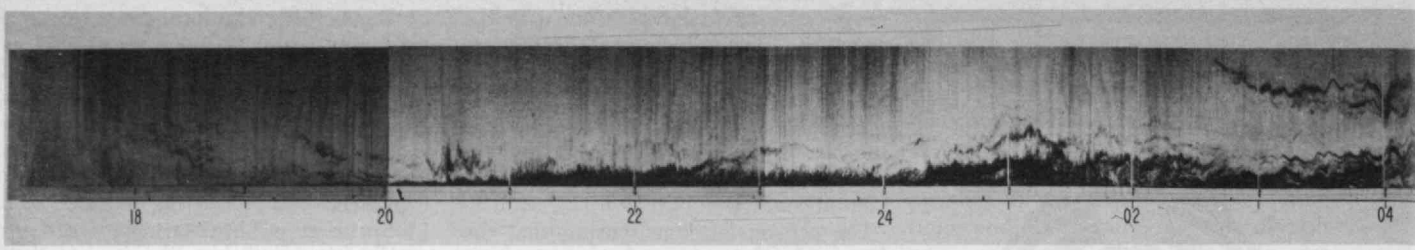
☐ But do so with care: "Citizen law suits. . . . are expensive and time-consuming . . . [and] should never be undertaken without competent, experienced attorneys." The names of such can be had from "the Natural Resources Defense Council, . . . 36 W. 44th Street, New York, N. Y., 10036, or the Environmental Defense Fund, . . . 162 Old Town Road, East Setauket, N. Y., 11733."

The booklet lists other sources of information and help in setting up an effective citizen's action group. It concludes: "These guidelines for effective citizen action add up to hard work for concerned organizations. But hard work is precisely what's needed if the hope and promise of this latest American Revolution are to be realized."—*J.K.*

ENVIRONMENTAL MONITORING

Finding Organic Water Pollutants

With the exception of D.D.T. and the polychlorinated biphenyls (P.C.B.s), organic compounds are less known and understood as water polluters than inorganic ones. Thinking this unfortu-



This acoustic sounding stripchart made in Colorado shows an atmospheric inversion starting near the surface at 1900 local time. A higher-level inversion (700 meters) begins at 0230 and subsides due to high pressure. The two merge at 0800 creating an intense inversion layer, compelling Denver to call an air pollution alert. Huge waves occur at the interface. At noon, convective plumes (the grasslike pattern) break up the inversion.

nate, since some may be toxic and those not degradable—D.D.T. for example—may accumulate in living systems or in the water itself, two M.I.T. chemists set out to see how organics found in the Charles River as it flows past M.I.T. could be identified and perhaps measured.

After a year of study, Ronald A. Hites, Assistant Professor of Chemical Engineering, and Klaus Biemann, Professor of Chemistry, conclude (Science, *Vol. 178, pp. 158-60*) that the problem of identifying and measuring organics—a stumbling block in the past—"can now be overcome by the application of modern analytical instrumentation." Specifically, they used gas chromatography, mass spectrometry, and high-pressure liquid chromatography, with computer-assisted interpretation techniques.

The results demonstrate a plentiful supply of organics in the Charles River, which is generally recognized as "quite polluted"—a biological oxygen demand of 3 to 6 mg./l., according to a 1971 thesis by William W. Walker, Jr. The results for specific compounds range from 0.05 part/billion of pyrene to about 1 part/billion of a complex benzene derivative di(2-ethylhexyl) phthalate.

The largest concentration of naphthalenes (3.4 parts/billion) was found following a period of heavy rainfall, and further analysis convinced Drs. Hites and Biemann that such aromatic hydrocarbons originated in automobile exhaust and arrived in the river in street runoff. They think many other organics in the river are the products of algae and that some indicate the presence of fuel oil. One group of phthalate esthers turned out to be present in variable concentrations, and locating their source is "of particular interest" because they are widespread and may have genetic effects.—*J.M.*

Sounding Out Air Pollution

Air pollution is hard to put your finger on—sometimes, in fact, hard to detect by any sophisticated instrumentation. Here is a plan for detecting pollution by looking acoustically with an atmospheric "pinger" for the conditions under which pollution is most likely to exist.

In principle, the acoustic sounder detects atmospheric conditions conducive to air pollution rather as radar maps local weather conditions. Because sound waves consist of alternating compressions and rarefactions of the air—a purely mechanical effect—the acoustic perturbations caused by heated air masses are vastly more pronounced (over a million times more so) than those observed in electromagnetic radar waves. A loudspeaker/microphone sends up sonar-like sound pulses. The "pings" echo off the heated air, are picked up by the microphone, and are recorded on a moving strip chart. Intensity variations represent temperature variations.

The technique presently is most useful for showing the temperature structure (not the temperature itself) of the lower 1,500 feet of air as it flows past the sounder, reports Freeman Hall of the National Oceanic and Atmospheric Administration's Wave Propagation Laboratory, Boulder, Colo. "The [pollution-causing] inversion," says Dr. Hall, "can be viewed as a sheet marking the temperature discontinuity between cool air and the warm air above it. It is often a very dynamic region filled with waves that may be hundreds of feet high and . . . break like an ocean surf."

The sounder still cannot give the detailed humidity, wind speed, and temperature data of the airborne radiosonde, but it is in continuous operation and yields a considerably broader picture of the lower regions that may be used to supplement conventional radiosonde data. The noise of passing airplanes and trucks causes only minor interference problems, and Dr. Hall feels that further refinements will mostly be aimed at expanding the technique's capabilities.

"Eventually," he says, "we hope to use the acoustic sounder for reading the temperature itself, for observing the temperature profile of the inversion, and for mapping the lower atmosphere's humidity structure." Then by using the Doppler technique, converting frequency changes in the echoes into miles per hour, Dr. Hall plans to make wind-velocity measurements at any height from the ground up to 1,500 feet. The next step will then be a three-sounder array which will give continuous three-dimensional surveillance of the dynamics of the lower atmosphere.—*Michael Chiusano*

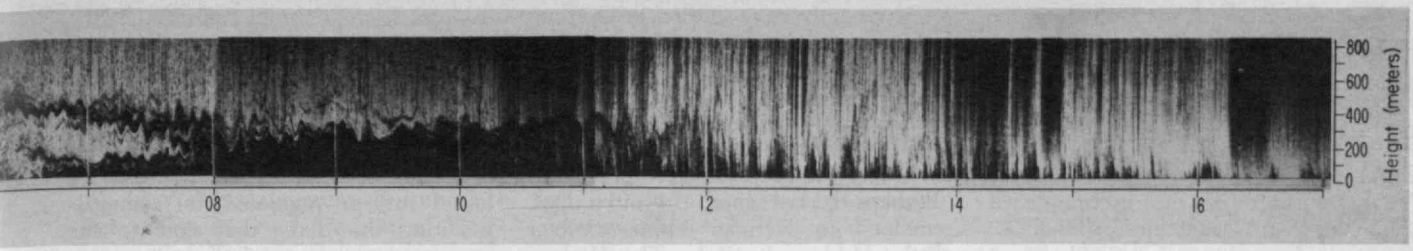
Seeing Air Pollution

Although the narrow, monochromatic light beam of a laser promises a multitude of uses, lasers have been slow in living up to early expectations—a fact that has prompted some to call the laser a solution in search of a problem.

It still is: Lincoln Laboratory workers are investigating lasers for identifying and measuring atmospheric pollutants. Two applications are under study for the Environmental Protection Agency—the measurement of ethylene as a constituent of automobile exhaust and of sulfur dioxide and particulate matter in smoke stack gases.

The plan is based on the absorption of light from a laser by pollutants and, especially, the selective absorption of certain wavelengths of light by certain pollutants. The facts that a laser produces monochromatic light and that its light can be collimated (the edges of its beam made parallel) to remain in a tight, thin beam over considerable distances make it a promising tool.

These characteristics allow E. David Hinkley and H. Alan Pike, both in Lincoln's Optics Division, to measure the amount of sulfur dioxide and smoke in a stack without placing their sensing device within the stack itself. The laser light is beamed into the stack through a viewing port; it returns from a reflector on the far side of the stack to a detector near the laser. Two different wavelengths of light are used; light at one wavelength, corresponding



to the absorption wavelength of sulphur dioxide, is diminished when reflected through the stack by both SO_2 and smoke, while light at the other wavelength is unaffected by SO_2.

Electronics then determines, on the basis of the ratio of the two readings, the concentration of sulfur dioxide and particulates in the stack gas.

A similar method on a large scale is used by Drs. Hinkley and Pike to measure the level of ethylene in the Lincoln Laboratory parking lot as people start their cars to leave for home. The laser beam is shined across the parking lot and returned from a reflector, for a total beam length of about a quarter of a mile. Attenuation of the light at the frequency absorbed by ethylene determines the average of this pollutant over the whole parking lot, at concentrations as low as one part per million.

Recent development at Lincoln Laboratory of similar lasers that emit light strongly absorbed by carbon monoxide and nitric oxide suggests that this method may soon be applicable to studies of these pollutants as well.—*J.M.*

THE FUTURE

The Great Debate: Modelling the Future

"Forrester-type" models—having become a genre all their own in three years since the publication of *Urban Dynamics* (1969) and *World Dynamics* (1971)—now hold a bright spot of controversy in the community of scholars concerned with technology, public policy, and man's future.

Indeed, it may be argued that by simply raising the questions of urban policy and world systems in terms which generate such wide discussion, Jay W. Forrester and his associates in M.I.T.'s system dynamics group and Sloan School of Management may indeed have postponed the catastrophe which their computers predicted for cities and ultimately for the world.

Here are some of the divergent views of "Forrester-type" models and their applications from a series of symposia given at the American Association for the Advancement of Science meeting last December:

Modelling the Urban Scene

☐ Leo P. Kadanoff, Professor of Physics at Brown University, tried to fit the history of Providence, R.I., from 1950 to 1970 into the model which Professor Forrester presents in *Urban Dynamics*. He failed: the model's prognostications for the 20-year development of Providence following initial conditions in 1950 bore no resemblance to the city as it existed in 1970. The problems, he thinks, are in definitions ("how is 'underemployed' defined?") and linguistics, and because the model does not display to its users the "arbitrary value judgements" which must have been involved in its creation. His conclusion: "Forrester-type" models "are little better than cocktail-party conversation for determining public policy."

☐ Otomar J. Bartos and Yung-Mei Tsai of the department of sociology at the University of Colorado reported a similar effort to validate the *Urban Dynamics* model with the history of four American cities from 1940 to 1960. Their conclusion is far more tolerant than Professor Kadanoff's: the *Urban Dynamics* model "is by far too pessimistic"—that is, it predicts trends toward urban disorganization and poverty which proceed far faster than they actually moved in the four cities. "The average process is different from that described by the *Urban Dynamics* model," and since the model—despite the author's warnings—is in fact being used for policy decisions there must be further studies to develop results that are "accurate, not too pessimistic or too optimistic."

In Professor Forrester's absence, it remained for Dennis L. Meadows, who worked at M.I.T. on the Club of Rome project which led to publication of *The Limits to Growth* before taking his present post at Dartmouth College, to respond. Everyone, he said, has in his mind if not on his desk a model for whatever phenomena he studies; all are in some sense valid, in other senses invalid.

It is not the object of the *Urban Dynamics* model to predict the precise value of one parameter; the purpose is to show the interrelatedness of many. There is no possibility of proving any such model absolutely true or false; it is reasonable only to ask, "Is this a better basis than we now have understanding how the variables relate?"

Limits to Growth?

When the stage was broadened to the world model (*World Dynamics* and *The Limits to Growth*), criticisms and comments ranged widely:

☐ The *World Dynamics* model is highly aggregated, meaning that it is grossly simplified—"one composite industrial output, one non-renewable resource, one 'pollutant,' the world as one unit," is how Ronald G. Ridker of Resources for the Future, Inc. explained it.

☐ Laurence I. Moss of the National Academy of Engineering, while fully sympathetic with the concept that growth must have finite limits, noted that in fact "the energy policy of this country is a crazy-quilt pattern of subsidies and perverse regulatory policies," and he fears that no such aggregated model can reasonably represent the behavior of such a system.

☐ The discussion of the world model's treatment of resource depletion was similar. Known reserves of any resource have never been a fair measure of the ultimate supply, and furthermore technology makes it possible for us to substitute one raw material which is in plentiful supply for another which is depleted; the model fails to comprehend these facts of resource reserves and substitutability, said Vincent McKelvey of the U.S. Geological Survey.

☐ What is the role of new technology in helping to resolve the constraints which presage catastrophe in the *World Dynamics* model? If everything else—population, pollution, resource depletion—grow at exponential rates, why not technology?

Why not, indeed? asked Chauncey D. Starr, who was then Dean of the School of Engineering and Applied Science at the University of California (Los Angeles); he came to the A.A.A.S. meeting in Washington with a complete mathematical theory to demonstrate that technology does indeed advance exponentially, that the *World Dynamics* model grossly underestimates man's ability through technology to expand the usefulness of a finite earth.

The same kind of reassurance came from Richard A. Carpenter of the Environmental Studies Board of the National Academy of Sciences. " 'Yes, Virginia, there is a technological fix,' " he said, paraphrasing the famous editorial. He sought to give his audience "real assurance of the usefulness of technology and economics; only if we reject these resources," he said, "must we accept the 'doom and gloom' school." He rejects "categorical answers to questions which should be answered in terms of the probabilistic character of technology."

☐ Another omission from the *World Dynamics* model, said Marc Roberts, Professor of Economics at Harvard: price feedback. Our economic system provides a powerful mechanism for controlling growth.

☐ Others found the *World Dynamics* model almost self-evident. "Man is a global ecological force," said John P. Holdren of the California Institute of Technology. "The idea that technology has the power to assure his safety is dangerous."

☐ Professor Meadows once more: resource availability and technological inputs do not really affect the basic question to which the *World Dynamics* model is addressed. It is this: "What is the behavior mode of our system?" We can easily change parameters and so change hypothesized results, but we must understand as we do so how the changes will really affect the variables with which they are introduced.

☐ Another observation, from Kan Chen, Geobel Professor of Advanced Technology at the University of Michigan: "Man acts in his own image." If people come to accept the *World Dynamics* model as a rational statement of the system in which they live, is it possible that "the world community would behave quite differently . . . in such a manner that the disaster predicted by the *World Dynamics* model would be avoided even without any conscious changes of public policies"?

Indeed, said Dr. Chen, "this may become the most significant impact of 'Forrester-type' models."

The Predicament of the Upper Classes

Though his view of the future was very different from that projected by Professor Meadows in *The Limits to Growth*, Dr. Ridker had the same sense of inadequate knowledge about man's long-term fate. "As one looks farther and farther into the future, our vision quickly grows so dim that at some point we must admit our total and absolute ignorance. We do not and cannot know what kind of disasters we may be letting ourselves in for by permitting growth to continue; but we are also ignorant of possible technological and institutional break-throughs that may not only save future generations from disaster but make them substantially better off than the current generation. And we do not know, and cannot know, for how long—for how many decades or centuries or millenia—we can keep the race up."

Perhaps the last word, as it often does, remained to Herman Kahn, director of the Hudson Institute. The Hudson Institute now is finishing work on its own model of the future, he said, and he finds the results reassuring. Barring a catastrophe (a cosmic event, or a nuclear war) and given "reasonable confidence" in the innovative powers of technology, said Dr. Kahn, "our current position is that the world can support reasonably high growth rates in gross national product and population for 100 to 200 years." This new model suggests that it will be a "middle class world," said Mr. Kahn; the life enjoyed by the upper classes may not be so possible in the future.—*J.M.*

INTERNATIONAL COOPERATION

An Agreement on Ocean Dumping . . .

The dumping of materials into the oceans is worrisome, although not as much so as other kinds of marine contamination. Recognizing that, the world's seafaring nations met in London in November to agree to a convention that would regulate ocean dumping.

The agreements are modest: there is a "black list" of substances that are never to be dumped and a "grey list" of those that may be dumped only with special permission. General permission may be given to dump substances that the sea can handle easily. A would-be dumper gets either permission from his own government; the convention sets no international penalties for disobeying it. The convention was made weak, so as not to interfere with the agreements that may come out of the United Nations conference the next year on the Law of the Sea, and whose provisions for ocean dumping will override those made in London. The convention also provides that regional, more stringent, arrangements may be made; one settled in Oslo by the North Atlantic nations in fact precedes the London agreement.

Nations and individuals are forbidden to dump materials such as mercury and cadmium compounds, those of the organohalogens, radioactive wastes, synthetic compounds slow to decompose, and the weapons of biological and chemical war. Grey-listed is matter such as heavy metals, pesticides, fluorides, cyanides, and bulky objects that might interfere with shipping or fishing. Exempt from control are the wastes from sea vessels or aircraft if they are produced from normal operations, those of mining and exploring operations, and of military activities.

The convention adds that all sources of pollution in the oceans must be found out and regulated, for some, as polluting the rivers that flow to the seas, are more harmful than dumping. —*J.K.*

. . . That Has a Few Inadequacies

The convention of ocean dumping (*see above*) drew on several different drafts and opinions for its final form. The original draft—as well as the impetus for the convention—came from the United States, and it was modified in several preliminary meetings. Before the London discussions, the American Society of International Law set a working group to studying the preferred drafts and in mid-November published the assessment. Some of the conclusions and suggestions apply as well to the draft that found approval.

Clearly, the most important part of an agreement on ocean dumping is the institution charged with administering it, and this was the part the London assembly skirted in its wish not to burden the Law of the Sea conference that begins in November. In a background paper to the Society's recommendations, Lawson A. W. Hunter, of Woods Hole Oceanographic Institution, listed four possibilities: an existing institution with scientific capabilities, the Intergovernmental Marine Consultative Organization (I.M.C.O.), a new institution created by the Law of the Sea meeting, and a new institution created by the ocean dumping convention. The working group felt that I.M.C.O. was a good possibility, as a group set up by the Law of the Sea conference also would be. But the institution must have its own solid scientific facility. And it must have clout.

The group felt that a "black list" and "grey list" would come to be easily outdated and not responsive to scientifically determined need. The group added that most of the substances on the black list in the draft (most of these were on the list adopted) given to the meeting were not being dumped in "significant quantities."

The group also wondered why military operations should be exempted: the same question probably applies also to the exemption given to exploration and mining projects.

The Law of the Sea conference will no doubt review the convention on ocean dumping—certainly its administration must be decided then.—*J.K.*

The Oil Railroad

How to transport oil from the Arctic to the energy-hungry U.S.?

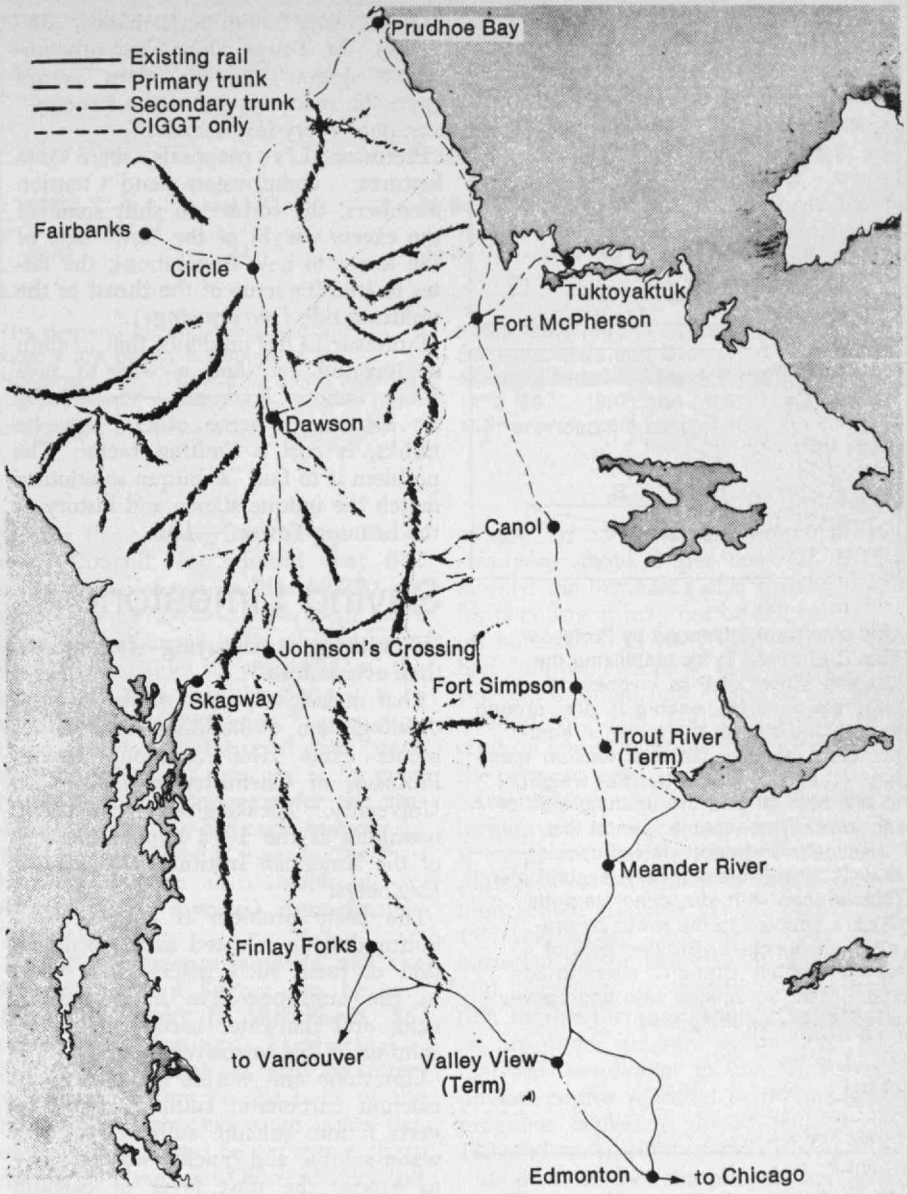
Pipeline? Tanker? Railroad?

R. L. Whitelaw, a railroad enthusiast who is Professor of Mechanical Engineering at Virginia Polytechnic Institute and State University, finds the last suggestion far from quaint. Indeed, he told the American Society of Mechanical Engineers last winter, a double-track line from Prudhoe Bay could deliver oil to Edmonton for 50 cents a barrel and liquified natural gas to Chicago at 25 cents per million cu. ft.

Professor Whitelaw's proposal is based on a fleet of 10 220-car continuously moving trains travelling at 50 m.p.h. and running 144 minutes apart along a 3,200-mile track from Prudhoe Bay to Chicago. Each train would carry its own fuel: less than 2 per cent of such a train's gas cargo would be consumed by its engine during the trip. The system would deliver as much oil and gas as a 48-in. oil pipeline and two 48-in. gas pipelines in the southbound direction—and the tracks would also be available for other cargo as well.

Professor Whitelaw's route would entail 1,370 miles of new right-of-way and a new double-track system over the remainder of the route. The cost might be $1 million per mile.

But do not think of Professor Whitelaw's as a railroad in the image of today's: "In projecting a $5 billion investment in an entirely new 4,000-mile railway system to serve a vast untapped territory, it would be an inexcusable blunder to perpetuate the railroad design and operating errors of the past," he told the A.S.M.E. So tracks and rolling stock are both to be of new design, and the plan envisions "total automation." For example, he writes, "the traditional caboose would disappear as an outworn relic of the past, to be replaced by television, and the entire crew would have 'quarters' in a permanent car behind the lead locomotives. A total crew of three men would be sufficient for an entire 33-hour journey, being responsible only for inspection, emergency operation, and maintenance—one man on duty, one man available, and one man asleep."—*J.M.*



R. L. Whitelaw, Professor of Mechanical Engineering at Virginia Polytechnic Institute, proposes that a railroad may be the most economical solution for transportation of oil from the North Slope to the U.S.A. Of several alternative routes for a high-speed rail line, he prefers the easternmost on this map. Trains carrying oil would terminate near Edmonton, on the existing continental pipeline network; those carrying gas would proceed over existing rights of way to Chicago.

"Fly-by-Wire"

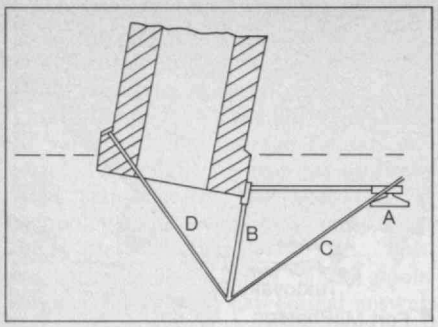
As aircraft grow in size, the mechanical connections between cockpit and control surfaces become complex—and heavy. Draper Laboratory engineers have adapted the Apollo inertial guidance system to replace such heavy mechanics with lighter electronics, and this "fly-by-wire" system has now been tested in a modified F-8 aircraft at the N.A.S.A. Flight Research Center at Edwards, Calif.

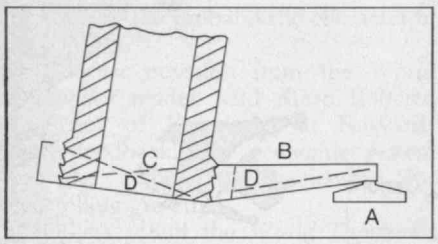
The plan for the electronics is simple: as the pilot moves a control pedal, sensors detecting its motion transmit a corresponding signal to an on-board computer. From the computer comes an appropriate instruction to the proper hydraulic motor, which moves the control surface.

Meanwhile, gyroscopes and accelerometers from the Apollo guidance system monitor how the plane's response compares with that directed by the pilot's pedal and provide a correction to the hydraulic motor if necessary.

Programmed in advance or by the pilot during flight, the Apollo elements can also provide automatic control along a prescribed flight path or immediate corrections—perhaps more accurately than the pilot can—in case the aircraft is affected by turbulence.

The weight-saving potential may amount to many hundreds of pounds in a large aircraft, and this advantage is said to be bringing the "fly-by-wire" system to the attention of space shuttle designers.—*J.M.*





One plan (top) advanced by Professor Yao T. Li of M.I.T. for stabilizing the Leaning Tower of Pisa involves 11 concrete pads (A), each 8 ft. dia., around the sinking side of the tower. A compression member (B) and tension members (C and D) would transfer weight to the pads and to the uplifting side of the tower. The scheme is a bit like "a suspension bridge viewed upside down," says Professor Li. A second plan (below): two 18-ft.-dia. concrete pads (A) are coupled to the tower by prestressed concrete (B). Two sets of tension cables (C and D) serve to add stability at the sinking side and convey stress to the uplifting side.

CONSERVATION

Saving a Landmark

Here are an aeronautical engineer's two solutions to a problem which may be critical by the year 2100 if not before: how to keep the Leaning Tower from leaning so far that it falls down.

The tower is now increasing its tilt by about 2 mm./yr., and the farther it leans the greater the force that causes its distortion. Now that there are signs of impending structural failure, the Italian government has ordered temporary reinforcement of the tower with a harness of steel cables, and a government commission will conduct an international competition for a plan to stabilize—but, of course, not straighten—the famous landmark.

Yao T. Li, Professor of Aeronautical Engineering at M.I.T., proposes two variations—shown in the sketch at the right—on the same concept to add stability to the tower beneath the ground. What he proposes is "equivalent to the use of a tail surface to stabilize an airplane while the main load is carried by the wing." He continues: "Like many high-performance airplanes, the Tower is an inherently unstable system"; so his plans permit "periodic readjustment of the structure, say, once every few decades."

Professor Li's proposals share two features: compression and tension members, the former to shift some of the excess weight of the "low" side of the tower to new foundations, the latter to transfer some of the thrust to the uplifting side (*see drawings*).

Professor Li has no doubt that modern engineering can find a way to save Pisa's famous landmark—whether by his scheme or some other. Nor, he thinks, is cost a limiting factor. The problem is to find "a unique solution to match the unique stance and history of the Leaning Tower."—*J.M.*

Saving Limestone

"Everything is decaying—faster now than ever before."

That melancholy view of the gradual disintegration of buildings and monuments came from Seymour Lewin, Professor of Chemistry at New York University, speaking to committee members at the 1972 annual meeting of the American Institute of Chemical Engineers.

The basic problem is air pollution. Sulfur dioxide released in the combustion of fossil fuels reacts with water in the atmosphere to make sulfuric acid, and rainwater becomes a dilute solution of this corrosive material.

Limestone and marble are principally calcium carbonate; sulfuric acid converts it into calcium sulfate, which is water-soluble and quickly washes away to expose the next layer of calcium carbonate. Hence the gradual pitting and roughening of limestone and marble structures and the whiteness of those portions of urban buildings where the rain acts fastest to bring sulfuric acid and carry away calcium sulfate.

The solution involves chemistry hardly more complex than the problem. Barium hydroxide applied to limestone results in the formation of barium carbonate; its properties are very similar to those of calcium carbonate, and its crystals fill the limestone pores.

Now when it next rains sulfuric acid there are two products: calcium sulfate and barium sulfate. Here is the key: barium sulfate is essentially insoluble. —*J.M.*

SCIENCE POLICY

Advocating Options for Technology

In the 30 years since the beginning of World War II, the U.S. has devoted its "largest intellectual resource" to problems outside of human, social issues. Now that wrong must be righted, says J. Herbert Hollomon, Visiting Professor of Engineering at M.I.T. So the Institute's new Center for Policy Alternatives, which Dr. Hollomon directs, is trying to look first at the urgent human problems that now appear in the society—and then work on the technology that seems most promising for their solution.

When it tackles such problems, the Center for Policy Alternatives will try to be exactly that: a resource which displays options and their consequences, not single monumental recommendations.

What sorts of things are on Dr. Hollomon's agenda?

☐ The U.S. balance of payments problem "is the major issue before the federal government as far as technology is concerned," thinks Dr. Hollomon. It is simply a fact, he says, that something must be done to impove the competitive position of the U.S. in world markets, and technology is surely a major resource which the nation must use.

☐ "Nobody looks at the costs of consumer durables when he makes the purchase decision," and the first fully funded project of the Center for Policy Alternatives is to identify the real costs of the materials, manufacturing, transportation and disposal of appliances—in contrast to the consumer's price tag. Already several M.I.T. graduate students and faculty and staff are at work on a study of home appliances, and Dr. Hollomon hopes eventually to move on to a study of the systems cost of the modern automobile.

☐ What about the need for research and development on energy sources and systems? Dr. Hollomon would like to mount a study of the institutional arrangements which now determine how research and development is—or is not—done. Are the conventional market incentives adequate? If not, why not? If so, why should there be massive inputs of federal funds for energy research (the breeder reactor, for example) which will in the end be exploited by private industry?

☐ A score or more of important questions are associated with industrial productivity. Where in the manufacturing sector would a productivity increase have most leverage? The construction industry has demonstrated productivity increases averaging but one per cent a year since 1945; why? What about the relationship of workers and machines in the $200 billion U.S. goods-assembly industries?

☐ The most ambitious proposal of all has to do with a comparative international study of technological incentives—such issues as government intervention in the promotion of tech-

nology, patent and venture capital systems, and international agreements. Dr. Hollomon thinks that U.S. policy for fostering innovation is at best based on "idiosyncratic experience." Japan, for example, seems to him to have a more organized approach, and so do other nations. But no one outside of government has ever done such a comparison of incentives.

☐ What about supply and demand problems in professional manpower? There's evidence now of a cyclical motion which is destructive of both people and institutions, Dr. Hollomon thinks. For example, a reported shortage of engineers encourages high school students to enroll in engineering schools; four to six years later when they graduate the market is suddenly oversupplied. So the next generation of students shuns engineering for other professions such as law and medicine, and engineers are suddenly in demand again. What options does the country and its educational systems have for damping such oscillations?

Dr. Hollomon's enthusiasm for his center is contagious, but he urges caution: can such analyses in fact be done in an educational institution? Two problems, he thinks:

☐ Issues such as these in social applications of technology seldom employ a discipline at its frontier; an economist analyzing research and development incentives, for example, is using very conventional economics. But most academic economists, seeing the advancement of knowledge as their primary function, want to work at the frontiers of their fields. Can they come to see that wise application of existing knowledge to relevant problems is also an appropriate function?

☐ Dr. Hollomon is determined that the Center's results will be presented in terms of options, not of policy recommendations; "we do not wish the Center to become an advocate," he insists. But he is already finding this a hard resolution to maintain. "Does one lose his integrity by failing to reach a conclusion?" he keeps asking his students and colleagues.—*J.M.*

Engineering: Prosperity Returns?

The sinusoidal cycle of manpower surplus and shortage which J. Herbert Hollomon (*see above*) wants to study may now be entering the phase of rapid change—at least for engineers. For U.S. engineering schools, with fewer students enrolled now than in any of the last five years, suddenly find themselves beseiged by corporate recruiters looking for bright new talent.

Surveying over 1,000 engineering employers this winter, the College Placement Council, Inc., found that 672 companies planned to hire 62,290 engineers in 1972-73—16 per cent more hires than planned by a smaller number of companies a year ago at the same time. This, said the Council, is "a considerable improvement" over anything reported in the past two years. And 1972-73 may turn out to be even better—a very good year for the students—since "the average number of hires per employer is even better than in 1969-70 when, in a similar survey, 803 employers reported approximately 70,000 hires."

M.I.T.'s experience suggests that the Council's current figures may be conservative. Robert K. Weatherall, Director of the Institute's Placement Office, finds that most company recruiters are still operating on the basis of the reduced budgets they were given two or three years ago; he expects a sharp upturn in Placement Office activity this spring.

Other indicators confirm the rising market for engineers. The Deutsch, Shea and Evans index of demand for scientists and engineers, based on recruiting advertising volume, is now at a three-year high. Four out of five electronics companies surveyed by *Electronic Design* magazine reported "many openings" for engineers. The U.S. Department of Labor estimated that the jobless rate for engineers in the third quarter of 1972 was 1.8 per cent—down from 2.6 per cent a year earlier. Geoffrey Potter, Project Director of Volunteer Engineers, Scientists and Technicians, a self-help project of the American Institute of Aeronautics and Astronautics, told the *New York Times* this winter he thinks unemployment in those fields may total only 50,000 and 60,000, down from 100,000 a year ago.

But the American Chemical Society is not so confident. Surveys conducted by its Office of Manpower Studies in cooperation with the American Institute of Chemical Engineers suggest a "very slightly improved" employment picture for 1973, with unemployment steady at about 3 per cent. If 1972 marked the beginning of a turn-around for chemists, it may not be felt in earnest until 1974; in 1973 there will be at best "minute increases" in employment. But almost about half of the companies queried by A.C.S. said they would recruit on more campuses in 1973 than in the previous year.

Are students, sensing a rising demand, turning to science and engineering? It seems not. Early evidence is that applications for admission to M.I.T. from high school students are as numerous this year as last. But the Biology Department has suddenly become the second largest in undergraduate registration in the Institute. Premedical studies are under pressure everywhere. At Harvard, enrollment in an elementary physics course required in pre-medical programs tripled in three years—from 120 students in 1969 to 366 in 1972.

At a time the sharpest future demand appears to be for engineers, freshman engineering enrollments in all accredited U.S. colleges and universities in the fall of 1972 were 14 per cent below those of 1971 and 35 per cent below the record levels of 1967. Accordingly, John D. Alden of the Engineering Manpower Commission of the Engineers Joint Council predicts that the classes graduated by engineering schools in June, 1972—the largest since 1950—will not be exceeded for at least the next five or six years.

Why this developing discrepancy between the supply and demand for new engineers? As Dr. Hollomon points out, though high school and college students are in fact responsive to demands as they perceive them, there is a time delay involved while the message of manpower needs filters into the consciousness of students and their parents. But more than that may be involved in the continuing resistance to engineering, thinks Mr. Weatherall: Students continue to be "wary of a profession which seems to have been very hard-hearted."—*J.M.*

	August	September	October	November
1962	123.5	123.2	110.7	115.5
1967	131.9	128.8	143.9	123.5
1971	44.7	39.6	45.1	42.0
1972	84.8	76.2	101.0	93.4

The demand for engineers and the supply are out of phase, says Dr. Hollomon. The demand is rising again, but the supply is still responding to the oversupply of the past few years. Shown in the table are the figures from the Deutsch, Shea and Evans, Inc. Engineer/Scientist Index for the fall months of 1972, 1971, 1967, and 1962. The year 1961 provided the base of 100.

The Famous School Girl Problem

Puzzle Corner:
Allan J. Gottlieb

Everything worked out well with my Ph.D. The degree was officially awarded to me on February 1; to celebrate I developed a case of the 'flu; I can only be thankful I didn't get sick a month earlier, when I hadn't a moment to spare. It's hard to believe I'm not a student any more. Oh, well, we all get old sometime.

To answer a popular question: my thesis was in dynamical systems, and my adviser was Mike Shub.

Problems

One of my favorite chess problems comes from Harry Nelson; he recalls that he first encountered it, or one similar to it, in the early 1950s. This is the way it came out when he reconstructed it for some friends in the 1960s:

M/A1 Two neophyte players at the local chess club, under the watchful eye of their teacher who made sure that every move was legal, adjourned their game for lunch, leaving the pieces on the board. When they returned a member of the club standing by their board apologized: "While I was walking by my sleeve happened to brush against one of the men on your board, and it was knocked off amongst the captured men. I don't know which piece it was, but it was on White's KR3 square." No one could remember what the piece was, and they were about to start another game when an old master player happened by. After the situation was explained, he studied the board for a few moments and then said, "There is only one man which could possibly have been on that square." He put it back and the game continued. Here is the position with "x" denoting the unknown man; what is it?

A fairly hard problem comes from my old colleague Mike Rolle:

M/A2 Prove the following:

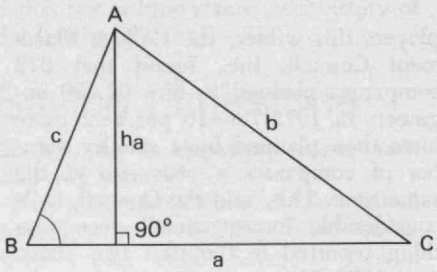
If (1) F is continuous from $(0, \infty) \to (0, \infty)$; and (2) for all $t > 0$, the sequence $F(t), F(2t), F(3t), \ldots \to 0$; then $F(x) \to 0$ as $x \to \infty$ $[x \in (0, \infty)]$.

This combinatorial question comes from Edward J. Sheldon, who calls it "the famous school girl problem." A reference in *Scientific American* in 1959 attributes it to the 19th century:

M/A3 Every day for a week (of seven days) a class of 15 school girls went for a walk. They walked in five rows of three girls each. Each day, each girl had two new "row" mates. How did they do this?

Here is one from Fereidoun Farassat which he says requires "a little knowledge of conic sections (parabola)":

M/A4 Draw a triangle given lengths a, $(b - h_a)$, and a and $(b - h_a)$, given angle b, and given that h_a is perpendicular from A to BC.



A number problem from John Hughes:

M/A5 Define $n\Delta = n(n + 1)/2$. When does $n\Delta + 1 = m^2$? Does the following algorithm work for finding the n and m?

$n(i) = m(i - 2) * 8 + n(i - 4)$.

Given: n and m are required to be integers.

Speed Department

Here is one from Alan D. Whitney:

SD1 Given the same source at the same temperature and the same cup and the same recipient, why is the second cup of coffee always hotter than the first? The third may be still hotter—but not necessarily so. It is *never* colder.

An electrical engineering problem from William W. Plummer:

SD2 Is there a way to wire three S.P.D.T. ("three-way") switches, two light bulbs, and a power source such that bulb A is on only if all three switches are on and bulb B is on if any of the switches is off? No relays, resistors, or diodes may be used.

Solutions

The following are solutions to problems published in *Technology Review* for December, 1972.

DE-1 Here is a hand actually encountered at the bridge table:

	♠ K 10 5 ♥ K 10 7 ♦ A Q J 4 ♣ J 8 3	
♠ 8 4 ♥ Q 9 8 6 5 4 ♦ 6 ♣ K 10 5 4		♠ 9 7 2 ♥ A ♦ 10 9 8 7 5 3 2 ♣ Q 9
	♠ A Q J 6 3 ♥ J 3 2 ♦ K ♣ A 7 6 2	

West leads ♦6. How is South to make six spades?

W. Bowman Cutter complains that we "laid out the hands wrong" or he "missed something vital, because it is very hard to find a way *not* to make six spades." Here is his solution:

Take the first trick in the closed hand and draw two trumps using dummy's ♠ K and ♠ 10. Play the ♦ A, ♦ Q and ♦ J, discarding the three small clubs from the declarer's hand. Lead the ♥ 7 to East's ♥ A, discarding any heart from the closed hand. Capture any return East can make in the closed hand and draw the last trump (assuming East did not lead it when in the lead with the ♥ A). Lead a heart toward Dummy's ♥ K and ♥ 10, and West's ♥ Q is finessed. The remaining three cards in the closed hand are high.

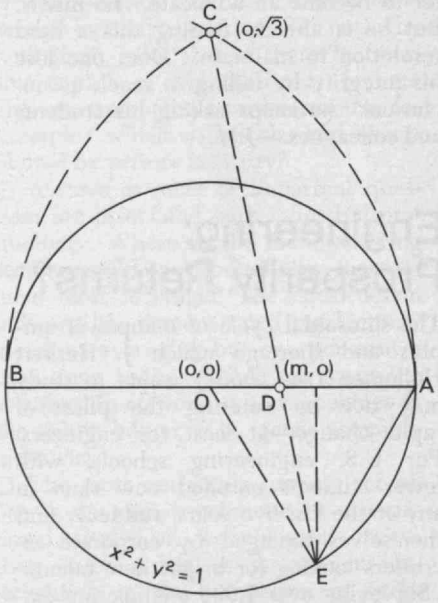
Also solved by Peter Groot, Barry Kington, John Meader, R. Robinson Rowe, Daniel Sheingold, Eugene Spiegel, and Patrick Sullivan.

DE-2 Give an algebraic proof of the following geometrical construction method for inserting within a circle a figure of any number of sides:

1. Draw the diameter of any circle you may have chosen.
2. Divide this diameter into the number of units you wish to have inscribed in the circle.
3. At the extremities of this diameter, scribe two intersecting arcs with radius equal to the diameter.
4. From the intersection of these two arcs draw a line through the second division point from the circle, extending it to the circle.
5. From this intersection with the circle, draw a line to the (zero) point of the diameter on the circle. This line will then be the side of a figure inscribed in the circle, having the number of sides into which the diameter was divided.

The following is from R. Robinson Rowe, who assumes that the inscribed figure is to be a *regular* polygon; otherwise, he says, the problem would be trivial:

The proposition is not generally true, and analytic geometry is used to find the particular number of sides, n, for which it is true.



n	m	cos AOE	AOE	AOE'	Error
3	$-1/3$	$-1/2$	120°	120°	0
4	0	0	90	90	0
5	1/5	$(15+\sqrt{73})/76$	71.953	72	−0.047°
6	1/3	1/2	60	60	0
7	3/7	$(21+\sqrt{129})/52$	51.518	51.429	+0.089
8	1/2	$(6+\sqrt{10})/13$	45.187	45	+0.187
10	3/5	$(15+\sqrt{57})/28$	36.356	36	+0.356
12	2/3	$(18+\sqrt{76})/31$	30.473	30	+0.473

Let AB be the diameter of a unit circle with center at 0, divided into n equal parts and with the second division point from A located at D = (m, 0). Thus AD = 4/n = 1 − m. The two construction arcs intersect at C = $(0, \sqrt{3})$, and the equation of line CD is

$x = m(1 - y/\sqrt{3})$

Line CD intersects the circle $x^2 + y^2 = 1$ at point E, with an abscissa which is the cosine of angle AOE; that is,

cos AOE = $x_E = m(3 + \sqrt{3 - 2m^2}/(m^2 + 3)$.

But AOE is the central angle of chord AE, which allegedly is one side of a regular n-gon, for which the central angle should be

$AOE' = 2\pi/n = \pi/2\ (1 - m)$.

The table at the top of this page will show that AOE = AOE', as alleged, when and only when n = 3, 4 and 6.

Also solved by Gerald Blum and Frank Rubin.

DE-3 In each of the 16 squares of the figure below place a *different* letter, selected so each row, column, and long diagonal will spell a *different* four-letter word when the letters are selected consecutively in one or the other of the only two possible directions, as we do with numbers. There will be a total of 10 different words, all of which must be defined in any one edition of Webster's dictionaries.

No solution received so far has satisfied all the conditions, although the proposer claims to know of one. Keep trying.

DE-4 The area under the curve

$y = \cos x,\ 0 \leq x \leq \pi/2$

and the line y = 0 is to be divided into four equal areas by a line parallel to the y-axis and another line. Give the equation of the two lines. (In the drawing, areas $A_1 = A_2 = A_3 = A_4$.)

The following is from Gerald Blum; who says this one "is easy if you set it up properly":

Let L_1 be defined as x = c (it is misdrawn in the published diagram), and let L_2 be defined as y = mx + b; c, m and b are constants to be determined. Define the x-coordinate of the point where L_2 intersects the curve as x = d, where d is another constant to be found. Since the total area under the curve is 1 (a trivial integral), we have $A_1 = A_2 = A_3 = A_4 = 1/4$. From $A_1 = A_3 = 1/2 = \sin c$ on doing the integration, we quickly find $c = \pi/6$. Substituting this into the expression found by integrating A_3 gives us

$(\pi^2/72)m + (\pi/6)b = 1/4$.

Subject to the restriction $0 \leq b \leq 1$, this equation generates a family of L_2's, all of which satisfy the conditions of the problem. Although the simplest equations for d are cos d = md + b and sin d − $md^2/2$ − bd = 1/2, these are both transcendental. Taking these two with the identity $\sin^2 + \cos^2 = 1$ and the equation for m and b above, we can generate a purely algebraic expression for d in terms of b. This expression can be considerably simplified by a sort of scale change substitution as follows. Define $M = \pi^2 m$ and $B = \pi b$ and $D = d/\pi$. The result, after some algebraic simplification, is

$36(3 - 2B)^2D^4 + 24B(3 - 2B)D^3 + [(3 - 2B)^2 + 9]D^2 + 4BD - 3 = 0$.

This yields two easy solutions, B = 3/2 and D = 1/3, and B = 0 and D = $(\sqrt{\sqrt{13} - 1})/6$.

Also solved by Peter Groot, B. Rouben, R. Robinson Rowe, and Les Servi.

DE-5 Find all solutions to

$\sin(x + y) = \sin x + \sin y$

The following is from B. Rouben:

Since we have the identity $\sin(x + y) = \sin x \cos y + \cos x \sin y$, the equation becomes

$\sin x \cos y + \cos x \sin y = \sin x + \sin y$

$\sin x(\cos y - 1) = \sin y(1 - \cos x)$

$(\sin x)/(1 - \cos x) = -(\sin y)/(1 - \cos y)$ (1)

unless $1 - \cos x = 0$ or $1 - \cos y = 0$.

The latter condition implies either $x = 2k\pi$ or $y = 2k\pi$, with k any integer. Returning to (1), and using $\sin 2\theta = 2 \sin\theta \cos\theta$ and $\cos 2\theta = 1 - 2\sin^2\theta$, we obtain $(2 \sin x/2 \cos x/2)/2 \sin^2 x/2 = -(2 \sin y/2 \cos y/2)/(2 \sin^2 y/2)$

$\cot x/2 = -\cot y/2$

which implies $x/2 = -y/2 + k\pi$, where k is any integer;

$x = -y + 2k\pi$, where k is any integer.

Thus all solutions to the problem fall under three categories:

1. $x = 2k\pi$, y = anything;
2. $y = 2k\pi$, x = anything; and
3. $x = -y + 2k\pi$, k being any integer.

Also solved by Gerald Blum, Peter Groot, Ron Moore, John E. Prussing, Henry Radoski, Robert Rogoff, B. Rouben, R. Robinson Rowe, Frank Rubin, Victor Sauer, Les Servi, and the proposer, Richard Lipes.

As promised, here is Peter Groot's solution to JN-3 as revised in the December issue:

JN-3 Show or prove that

$$\left(\frac{1-x}{1+x}\right)(2x+1)\prod_{k=1}^{\infty}\left\{[1+x^{2k}]\left[1+\left(\frac{x}{1+x}\right)^{2k}\right]\right\} = 1$$

$$-\frac{1}{2} < x < 1.$$

Separating products,

$$\frac{(1-x^2)}{(1+x)^2}[(1+x)^2 - x^2]\prod_{k=1}^{\infty}$$

$$[(1+x^{2k})]\prod_{k=1}^{\infty}\{(1$$

$$\stackrel{?}{+}\ [x/(1-x)]^{2k}\} = 1$$

Now $\prod_{k=1}^{\infty}(1 + q^{2k}) =$ by expansion $1 + q^2 + q^4 + q^6 + \ldots = 1/(1 - q^2)$ if $|q^2| < 1$.

For q = x, $-1 < x < 1$.

For $q = x/(1 + x)$, $-\frac{1}{2} < x < \infty$.

So $-\frac{1}{2} < x < 1$ converges for both.

$$(1-x^2)\frac{(1+x)^2 - x^2}{(1+x)^2}\cdot 1/(1-x^2)$$

$$\stackrel{?}{\cdot}\ 1/\{1 - (x/[1+x])^2 = 1$$

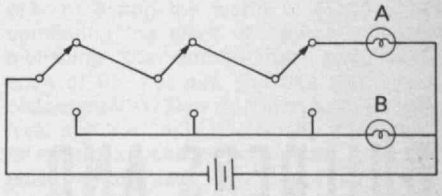
$[(1 + x)^2 - x^2]/(1 + x)^2$

$\cdot (1 + x)^2/[(1 + x)^2 - x^2]$

$= 1.\quad 1 = 1.$ Q.E.D.

Solution to Speed Department Problems

The solution to **SD1** is left to our readers. The solution to **SD2** is in the diagram below; Mr. Plummer notes that it "clearly extends to any number of switches, but knowledge of that fact seems to make the solution easier to find.



Allan J. Gottlieb, whose undergraduate degree in mathematics was given by M.I.T. in 1967, teaches at North Adams State College. Send solutions and new problems to him at the Department of Mathematics, North Adams State College, North Adams, Mass., 01247.

(*Continued from p. 8*)

they were in the past mainly because many more people and industry have moved in. (Although the explosiveness of California's population growth has become almost legendary, Nevada and Arizona have exceeded it proportionately).

In view of this, it is a supreme paradox that Southern California cities may be less menaced by befouled air than is one of the nation's most remote reaches—and, by sad fate, one of its most hauntingly beautiful. The Colorado Plateau is that high, dry country dissected by the Grand Canyon and its precipitous tributaries, also called "the Four Corners" because Utah, Colorado, Arizona and New Mexico come together on its eastern edge. It is a land of muted mesas and painted deserts, of pine-crowned mountains that soar incongruously from vast sagebrush plains. Much of it also happens to be underlain by enormous quantities of cheap coal. The coal may turn out to be the plateau's ecological undoing.

Gargantuan Generators

Everyone must have learned by now of the exponentially increasing demand for electrical energy. It is interesting, though, that while the per capita consumption of energy in the Pacific Southwest has not multiplied as rapidly as that of the U.S. as a whole, the population of the region is mushrooming at almost two and a half times the national rate. So, if projections are correct, the region will need more than four times as much electricity in 1990 as it used in 1970.

Not surprisingly, the utilities and the Bureau of Reclamation, the federal powermaker for the West, became more than slightly aware of this trend some time ago and began to stake out new sources of fuel. The coal of the Colorado Plateau was an obvious answer. There were comparatively few neighbors to object; and since the mineral rested on Indian reservations, manpower was plentiful, and the deposits could be bought and mined economically. A consortium formed to do precisely that.

What emerged thereafter was impressive even on the scale by which one judges present-day technology; a gargantuan design for a series of six coal-fired plants, strung out across the plateau and adjacent areas, that by 1985 could generate 10,352 megawatts of electricity —three times the output of the Tennessee Valley Authority. One of them alone, the proposed 5,000-megawatt Kaiparowits station in southern Utah, would be the largest coal-burning power facility in the world, serving nine states, with a capacity that could electrify New York City.

The first of the plants, the Four Corners site near Farmington in northwestern New Mexico, became fully operational in mid-1970. By then, it was emitting 240 tons of ash and soot a day, almost the equal of all the sources in Los Angeles (110 tons and New York (140 tons) put together. There were complaints that the plume of solid particles could be traced as far as 150 miles away and that the horizons were vanishing in these wide, once-open spaces.

"Not long ago, mention of the arid Southwest was likely to evoke images of cacti. . ."

Precipitators and scrubbers have been installed since then, as they will be at the other locations. They are designed to eliminate all but approximately one per cent of the particulates. But then, Four Corners is only one plant. Less than 30 miles distant, a second should be completed this year. Yet another is already operational at the southern tip of Nevada. Two more are being built, one near Price, Utah, the other on the Navajo complex on the Arizona shore of Lake Powell. The Price plant, incidentally, is under construction within a narrow chasm, prompting John McComb of the Sierra Club to worry that "driving down that canyon will be like driving into a smokestack." Finally, the giant at Kaiparowits, proposed for the Utah side of Lake Powell, only 30 miles from the Navajo, remains on the drawing-boards.

No one contends, whatever happens, that the Southwest will ever again be quite the bright, crystalline place it was back in, say, 1960. But at this juncture, an observer can become mightily confused, depending upon whether he hearkens to the pronouncements of the utilities and their researchers or to those of the environmentalists and their experts. Given the most sophisticated of currently available tools, for example, how much fly ash would the coal-burners still spew out over the Southwest? Its operators insist that the Four Corners unit should emit no more than 12 tons a day. Conservationists claim that it will be closer to 40 tons—and that the six stations altogether could pour out 240 tons.

Some conservationists argue that even if the plants observe the most stringent regulations now on the books, visibility could still be reduced to 12 or 15 miles in northern Arizona, roughly the distance across the Grand Canyon.

Your Clean Heat Is Dangerous

Meteorologists and public health officials worry more about what they cannot see than what they can. Even if all the visible particles were removed, the smokestacks would continue to release considerable amounts of sulfur and nitrogen oxides, which can react photochemically in the atmosphere to become serious pollutants. No techniques exist for reduction of nitrogen oxides; those for decreasing sulfur dioxides are only a bit better than primitive.

The problems are compounded by inadequate data on air quality in the region before work began on the new power generating system, and by the fact that the legislation and the technology that can protect the environment have evolved somewhat unpredictably. Spokesmen for the Mojave plant in Nevada have pointed out that what was a perfectly legal plant when construction commenced, was illegal, under air-quality laws, before construction ended.

Nevada provides an excellent case history of the dilemmas involved. Although officials in Las Vegas have complained about the ash put forth by the Mojave generators, they depend to no small extent on the power the Mojave generates. Las Vegas is not famous for the subtlety of its neon signs, which tend to be large and garish. Gambling casinos account for 11 percent of the electricity used there, and 4 percent of one casino's electric bill goes to light up one sign. Whether the signs are essential is not the point. The point is that there are conflicting values that somehow must be resolved.

Values have not always been defined, nor alternatives explored, and this has led to misunderstandings within the federal family, among other places. The Bureau of Reclamation is part-owner of the Navajo plant and is involved in one way or another with all the others. Yet the National Park Service has grumbled publicly that the esthetic worth of its holdings is threatened.

When all the plants are on line, about 60 percent of their output will be used by Southern California. One Four Corners resident, whose home is almost within the shadow of the smokestacks, told a Senate hearing that he must pay more for electricity than people pay in Los Angeles, and he suggested that California utilities be compelled to insert this line in their advertising: "Your clean electric heat may be dangerous to someone else's health."

Carle O. Hodge is Research Coordinator at the Environmental Research Laboratory of the University of Arizona.

How Not To Be Revolutionary

Book Review:
Cyril S. Smith
Institute Professor of Metallurgy and Humanities Emeritus, M.I.T.

The Experimenters: A Study of the Accademia del Cimento
by W. E. Knowles Middleton
The Johns Hopkins Press, Baltimore and London, 1971, 415 pp., $22.50

Among the organizations formed to promote the natural sciences prior to the formation of the Royal Society and the Paris Academy, none has received more attention from historians than the small group assembled in Tuscany under the patronage of Prince (later Cardinal) Leopold de Medici, which flourished between 1657 and 1662 and was disbanded in 1667.

The *Accademia* designed and constructed thermometers and barometers and other simple apparatus for experiments on the nature of air pressure, on magnetism, thermal expansion, the freezing of liquids, the expansive force of ice, and other topics. The best known source of information on the academy was the *Saggi di naturali esperienze* published in Florence in 1667, here newly translated. Middleton has richly supplemented this with details from a surviving transcript of the actual "Great Diary" kept by the rather unimaginative secretary of the Academy, as well as unpublished contemporary correspondence. The loss of records of other short-lived groups has given the *Accademia* a prominence that is perhaps not merited by its actual influence on science, but the records throw much light on the problems of research organization in the earliest days of modern science. The problems of achieving a balance between the conflicting benefits of individual inspiration or organization, patronage or freedom, and cooperation or competitive challenge which are present in today's complicated computerized laboratories can already be seen in this simpler world of glass thermometers and barometers, pendulums and vacuum-killed animals.

Taking its motto from Dante, *Provando e riprovanto* the *Accademia* aimed to prosecute the newly-formulated experimental approach to knowledge. Though it was a new kind of institution, dedicated to a new kind of intellectual adventure, it worked squarely within the conventions of its time and place, counter-reformation Italy. Quite unbaconian it had no ambitions of aiding the world at large through the application of natural knowledge—only of aiding the world of learning by continuing the work of Galileo and demolishing the authoritarian pseudoscience of the Schools. But this world had condemned Galileo not twenty years before, and the *Saggi* avoids any attempt to formulate a general world view. It is almost painfully empirical. There is none of the controlled speculation that makes, for example, the nearly contemporary *Micrographia* of Robert Hooke such stimulating reading even today. The individual contributions of the members were not identified—a condition which Middleton, noting the frustration of Project scientists today, believes was responsible for the departure of three principal members and the final collapse of the organization in 1667. The most important experiments were done before 1662 and the book was in print in 1667, but copies of it did not reach the hands of transalpine scientists until 1672, by which time the prompter publication of better works by Hooke, Boyle and others, had forestalled whatever impact the experiments might have had.

Middleton's translation of the *Saggi* and particularly his study of the organization and disintegration of the Accademia is priority reading for anyone who wants to understand that exciting century, the seventeenth, and will be highly suggestive to students of science and society today.

Can Construction Be Managed? How?

Book Review:
J. Karl Justin
Vice President
John Carl Warnecke and Associates

Construction Management Practice
by S. Peter Volpe
John Wiley and Sons, Inc., New York, 1972, x—182 pp., $9.95

Construction Project Management
by Richard H. Clough
John Wiley and Sons—Interscience, New York, 1972, viii—264 pp.

Both of these books have been long needed, and both are excellent in their own ways. But neither does what its title implies to many professionals.

These two volumes highlight one of the current problems in the construction industry: an exact definition of construction management. In recent years, certain companies, primarily large contractors, have called themselves "construction managers," considering their function to be overall coordination of a building project from initial plan through all stages to final completion. This move was interpreted (and probably correctly) as a way of enlarging the scope of the contractor's involvement in the total construction process.

But architects and consulting engineers quickly moved to protect their traditional position as representatives of the owner, so that currently professionals are speaking of "project management" to encompass their interpretation of construction management.

Whoever does the job, this broad-scale responsibility is the proper definition of construction management, and what has long been needed is a primer for the construction industry as a whole, spelling out all the phases of building and defining the roles of all who take part. Neither of these books does more than a piece of the job because both cover only the management of the final construction phase.

Coping with the Cop

S. Peter Volpe is the head of a well-established construction firm. He has had 35 years in the construction industry, and his book—according to the jacket—is directed to other contractors who may not be as experienced. His language is simple; his tone is moral. However, his book, while much more directly informative than most, leaves out some plain talk about the day-to-day facts of contracting's life—coping with the cop on the

beat; handling the owner and architect in common, a touchy situation; relationships with union delegates. There are a few pages on labor relations that stress "fairness," "loyalty", and getting to know union people on a first-name basis.

Mr. Volpe does mention the possibility of strikes.

But he does not by any stretch of the imagination cover construction management as it is commonly considered by the professionals in the industry.

Richard H. Clough's book is written at a more theoretical level, with very heavy concentration on the use of the Critical Path Method (C.P.M.). But Professor Clough also has not made the mistake of recommending too heavy dependence upon the computer. He has recognized that manual methods sometimes have advantages in permitting one to think through the reasons for the calculations, as well as arriving at the final numbers.

Professor Clough, except for a small moan that the strict jurisdictional structure of the A.F.L.-C.I.O. construction unions has a complicated effect on manpower leveling, ignores the existence of the unions altogether. He barely touches on relations with others on the job—architect, engineers, the owner—but makes a point that the contractor's project manager must be given a clear delegation of authority by his company's top management and must be implemented in holding his own with field personnel. It sounds almost as if he had had a bad time with a construction superintendent at some point before he became a professor.

Also, probably because Professor Clough is a civil engineer, this book overlooks many of the problems that may face a contractor, for example, on a high-rise building or a university complex, or a major hospital. His example of a small, single-span bridge may serve to illustrate C.P.M. utilization, but it cannot encompass the whole story even from the contractor's point of view alone.

Wanted: Someone to Tell the Real Story

What neither of these books recognizes is that project management or construction management, or whatever we call it, must start long before the construction phase of any job. Professor Clough does say that construction management should precede the building phase, and he also points out that C.P.M. can be applied to design as well as construction; but his project manager is strictly concerned with only the final stage. The construction manager, whether he be that *per se* or the design professional, cannot turn over his responsibility to the contractor's "construction manager" as actual building commences.

In this vein, an important reasonably up-to-date reference source on this general subject is *Professional Construction Management and Project Administration* by William Foxhall; it is a comprehensive treatment of this subject published just last year.

But what is still needed is the basic primer on building construction covering everybody's involvement—planners, architects, engineers, contractors. And somebody still has to tell it like it all is.

An Institute Informant

The Editors' digest of recent and current concerns at the Massachusetts Institute of Technology

100 Years of Women

To mark the centennial of the first woman's graduation from M.I.T.—she was Ellen H. Swallow—1873—who studied metallurgy—the Association of M.I.T. Alumnae will conduct a symposium on the status of women at M.I.T. and in the professions on June 2 and 3, 1973.

Among the speakers thus far confirmed: Jerome B. Wiesner, President of M.I.T.; Admiral Elmo Zumwalt, Chief of Naval Operations; Mary Rowe, economist with Abt Associates; Alice Donohue, Head of the Executive Personnel Branch of the Office of Civilian Manpower Management; Alva C. Cooper, Director of Career Counseling at Hunter College; Grace Ferrill, Director of the Women's Bureau, Northeast Region, U.S. Department of Labor; Marvin C. Grossman, President of Grossman Sales, Inc.; Howard L. Levingston, President of Electro Connective Systems, Inc.; L. Dennis Shapiro, President of Aerospace Research, Inc.; Morton Goulder, Vice President of Sanders Associates, Inc.; Marvin G. Schorr, President of Technical Operations, Inc.; James R. Killian, Jr., Honorary Chairman of the M.I.T. Corporation; and Helvi Sipila, Assistant Secretary General of the United Nations for Social and Humanitarian Matters.

For further information, write Susan E. Schur, Chairman of the A.M.I.T.A. Convocation Committee, at Room E19-434, M.I.T., Cambridge, Mass., 02139.

Automotive Pollution: Not Yet Solved

John B. Heywood, Associate Professor of Mechanical Engineering who directs M.I.T.'s Sloan Automotive Laboratory, told the Associated Press this winter that the automobile industry "will not be able to meet the 1976 air pollution standards by '76, even with catalytic attachments." But the goals are not impossible, he said. "The lead time to 1976 is simply too short; the automobile industry probably will need two or three more years."

Symphony on Tour

The most ambitious tour in its history will take the M.I.T. Symphony Orchestra across the country between March 23 and April 1. Evening performances are scheduled in Philadelphia (Academy of Music) on March 23, Dallas (McFarlin Auditorium of Southern Methodist University) on March 24, San Francisco (War Memorial Opera House) on March 26, Los Angeles (Scottish Rite Auditorium) on March 30, and Chicago (Symphony Hall) on April 1.

In each case tickets will be available at the door. The programs, identical for the five cities, will include two *nocturnes* by Debussy, the E Flat Concerto for Two Pianos by Mozart (Professors John L. Buttrick and Robert S. Freeman of M.I.T. as soloists), Brahms' *Symphony Number 2*, and Metamorphoses, five pieces for small orchestra by Barry Vercoe, Assistant Professor of Music.

It was two years ago when the Orchestra, conducted by David M. Epstein, Professor of Music, first played in Carnegie Hall, New York, that Theodore Strongin of the *New York Times* discovered M.I.T.'s music programs. "Shades of Leonardo!" he wrote, "It was a concert that would have been a credit to a professional orchestra!"

Summer Study at M.I.T.

Forty-five short courses in new developments in technology and related fields will be given at M.I.T. during the summer of 1973. Though various levels of preparation are suggested, all are planned for professional men and women who want to keep pace with changes in their fields—or in related areas. Tuition ranges from $375 to $900.

Here is the list:

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Technological Innovation in Building Systems within the Urban Context, Albert G. H. Dietz, August 6-10
Computer Aids to Architecture, Nicholas P. Negroponte, June 11-22

Biophysics and Medicine:
Biological Effects, Hazards, and Medical Uses of Non-Ionizing Radiations, Padmakar P. Lele, June 25-29
Biomedical Physics and Biomaterials Science, H. Eugene Stanley, June 18-22
Enzymes and their Use in Analysis and Clinical Diagnosis, Jean-Pierre Flatt and George Wolf, June 25-29
Experimental Pathology and Toxicology, Paul M. Newburne, June 5-9
Physical Aspects of Nuclear Medicine, Gordon L. Brownell, July 23-27

Chemical Engineering:
Modeling, Simulation, and Optimization of Chemical Processes, Lawrence B. Evans, June 20-29

Civil Engineering:
Analysis and Design of Transportation Systems, Marvin L. Manheim and Wayne M. Pecknold, August 13-17 and 20-24
Engineering with Viscoelastic Materials, Frederick J. McGarry, July 9-13
Case Studies in Water Resources Planning, Frank E. Perkins, June 25-29

Economics:
Econometric Analysis of Financial Markets and the Monetary System, Gordon R. Sparks, July 9-13
Applied Urban Economics, Ronald E. Grieson, August 20-31

Electrical Engineering:
Advanced Software Engineering, John J. Donovan and Stuart E.Macnick, August 6-17
Digital Signal Processing, Alan V. Oppenheim, August 13-17 and 20-24
Optimal Control and Estimation Methods for Engineering Design, Michael Athans, August 6-17

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ANNOUNCEMENTS

TECH. ASSESSMENT & TRANSFER
Int'l Conf. on Technology Assessment, The Hague, May 27-June 3. NATO Adv. Study Inst. on Technology Transfer, Paris, June 24-July 6. Information: Marvin J. Cetron, Forecasting Int'l Ltd., 1500 Wilson Blvd., Arlington, Va. 22209. (703) 527-1311

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Energy:
Energy: A Unified View, David J. Rose, July 30-August 10

Environmental Engineering:
Transportation and Urban Noise, Richard H. Lyon, July 23-27
Programming Environments for Human Use, Gary Hack and Virginia Ayers, July 24-August 2
Regional Analysis of Potential Offshore Petroleum Developments, John W. Devanney, III, August 13-17

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Financial Management and Strategy, Gerald A. Pogue and Stewart C. Myers, July 9-13
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Management Science in Marketing, Alvin J. Silk, June 18-29
Dynamics of Health Service Systems, Edward B. Roberts, August 20-24
Management of Research, Development, and Technology-Based Innovation, Edward B. Roberts and Donald G. Marquis, June 18-29
Facilities Management and Inventory Techniques, Kreon L. Cyros, July 30-August 3

Mechanical Engineering:
Strain Gage Techniques, William M. Murray, July 16-20
Two-Phase Flow, Boiling Heat and Condensation, Warren M. Rohsenow, July 30-August 3

Nuclear Engineering:
Nuclear Power Reactor Safety, Arden L. Bement and Norman C. Rasmussen, July 9-13 and 16-20
Principles and Methods of Nuclear Fuel and Power Management, Kent F. Hansen, June 18-22 and 25-29

Nutrition and Food Science:
Advances in Human Nutrition Knowledge, Vernon R. Young, July 23-27
Fermentation Technology, Daniel I. C. Wang, July 30-August 3
Physical, Chemical and Biological Aspects of Food Deterioration, Marcus Karel and Samuel A. Goldblith, July 23-27

Ocean Engineering:
Ocean Engineering Structures, Materials and Fabrication, Koichi Masubuchi, July 9-13
Ship Structural Design, J. Harvey Evans, June 11-15

Operations Research:
Decision-Making Under Uncertainty, Alvin W. Drake and Ralph L. Keeney, August 20-31

Photography:
Techniques in High-Speed Photography, Charles E. Miller and Harold E. Edgerton, June 18-22

Physics:
Cooperative Phenomena and Phase Transitions, H. Eugene Stanley, June 11-15
Lasers and Optics for Applications, Shaoul Ezekiel, July 23-August 3

Technical Writing and Editing:
Communicating Technical Information, Robert R. Rathbone, August 13-17

Urban Systems:
Analysis of Urban Service Systems, Richard C. Larson, July 23-27

Institute Review

Fewer Freshmen: Preserving the Quality of Campus Life

M.I.T. will admit fewer freshmen for the Class of 1977, which enters next fall, than have been in the Classes of 1975 and 1976.

The target in September, 1973, will be only 900—a return to levels typical of the early 1960s.

Many forces tend to push up the size of the admitted class, says Paul E. Gray, '54, Chancellor—the faculty's interest in more and better students, the continuing pressure from high schools, the number of ever-better-qualified students who want to come.

But one relentless problem holds admissions down: housing.

More and more undergraduates are electing to live in Institute houses and fraternities, and there simply will not be room for as many new arrivals. Last year and this, over 95 per cent of the freshmen living in Institute houses have wanted to return for the sophomore year —an astonishing figure which is without precedent at M.I.T. and probably without equal at those other American colleges and universities which do not require upperclassmen to live on campus. The cause is three-fold, thinks Kenneth C. Browning, '66, Assistant Dean for Student Affairs: the improving quality of the Institute houses, the shortage (and high cost) of housing in Boston, and the poor quality of housing near M.I.T. (There was a time, for example, when students would not take rooms in Burton House; now, completely remodelled, it is among the most desirable living places.)

The situation is temporary. Mr. Browning believes there will be room for only 870 freshmen in houses and fraternities next fall. But by 1974 there should again be spaces for an entering class of 950—as the large classes admitted in 1971 and 1972 depart. And the continuing demand for housing has moved dormitory construction into the Institute's top priorities, says Kenneth R. Wadleigh, '43, Vice President.

Several alternatives were considered and rejected by President Jerome B. Wiesner and Chancellor Gray before they concluded to temporarily drop the size of M.I.T.'s freshman class next fall: the requirement that freshmen live in Institute houses or fraternities (if they do not live at home) could be waived; additional students could be crowded into existing accommodations by converting more singles into doubles and doubles into triples; temporary housing could be arranged in Cambridge or elsewhere, off the campus; upperclassmen already in the houses could be required to find quarters elsewhere.

Dr. Gray admits that "reduction of the class size at a time when science and technology seem to be in public disfavor might be read as 'giving in.' But that," he insists, "is a non-issue. Applications are up from last year; young people are still interested in us and we are still interested in education.

"The decision has simply to do with the quality of student life at M.I.T. In the end, we decided to restrict the number who might benefit from an M.I.T. education in order to do a better job for those who are admitted."

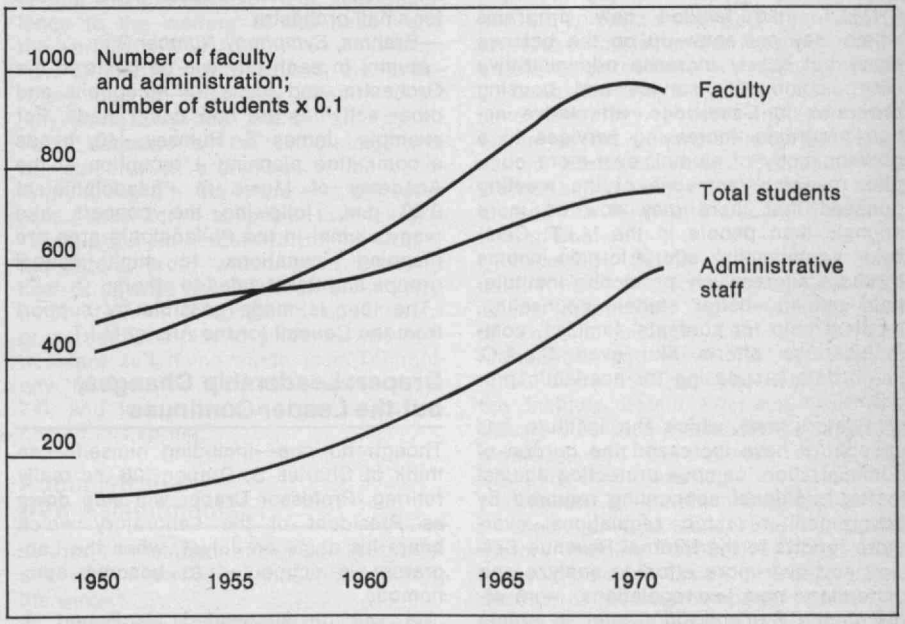
The Costs/Benefits of Administration

Is the M.I.T. administrative staff growing at a rate faster then demands upon it require? And is the administration really cost-effective?

No one expected that the answers would be so hard to find.

By January, a determined effort by Constantine B. Simonides, Vice President of M.I.T., Paul E. Johnson, Associate Director of the Institute Information Services, James J. Culliton, assistant to the Vice President—Administration and Personnel, and Richard E. Higham and his associates in the Office of Personnel Relations had resulted in some statistics, which they presented to the Corporation Joint Advisory Committee on Institute—Wide Affairs (C.J.A.C.):

□ In 1955, when the faculty numbered 511, there were 146 staff-level members



Is the M.I.T. administration really growing, and is M.I.T. getting its money's worth? Though the research was time-consuming, answering the first question of the Corporation's Joint Advisory Committee on Institute-Wide Affairs was relatively simple for Constantine B. Simonides, Vice President, and his associates.

But the second question turned out to be more nearly unanswerable; Professor Lawrence Susskind of C.J.A.C. may have expressed everyone's frustration when he noted that "no system can be responsive if it depends only upon those serving for an evaluation of their services."

of the administration—a ratio of 3.5 to 1. By 1960 the numbers were 633 and 249, for a ratio of 2.2 to 1. And at the end of 1972 the faculty was 948, administrative staff was 593, a ratio of 1.6 to 1.

☐ But the Institute's research staff, which the administration also serves, has been growing far faster than the faculty: from 1,069 in 1960 (comparable figures for 1955 seem to be unavailable) to 1,810 in 1972. Add faculty and research staffs together, and the ratios become 7 to 1 in 1960 and 4.6 to 1 in 1972.

☐ Still not the whole story. For there is a category of younger administrative people, called "exempt," who have not yet achieved staff status but who have significant administrative responsibilities; its members have grown from 99 in 1960 to 224 in 1972, while a similar category of "exempt" research employees has grown only from 260 to 583 in that 12-year period.

☐ What about the non-staff secretarial help required by this growing administration? No one knows just how to allocate the time of the Institute's non-staff employees between administration and academic/research responsibilities.

☐ And similarly, no one can say what proportion of the administration, however counted, is devoted to academic work and what proportion to research.

Another problem: it is far easier to count the administration than to count the number and complexity of jobs they do—even leaving out entirely the question of how well they do them. Some examples listed by Mr. Simonides for C.J.A.C. members at their January meeting:

☐ In 12 years since 1960 total expenses of M.I.T. have gone up nearly three-fold —from $97.5 million to $255.2 million. The residential plant (dormitories) has nearly doubled, from 770,000 ft.^{2} to 1,420,000 ft.^{2}

☐ M.I.T. has tackled new programs which may not show up on the balance sheet but surely increase administrative effort: community service and housing programs in Cambridge, affirmative action programs, increasing services to a growing body of alumni, ever-more complex research (someone at the meeting guessed that there may now be more animals than people in the M.I.T. Cambridge community), efforts to gain income by more aggressively promoting Institute-held patents, better student counseling, medical help for students' families, communications efforts like even C.J.A.C. itself, data processing for academic programs.

☐ Factors over which the Institute has no control have increased the burden of administration: campus protection against thefts, additional accounting required by government research regulations, ever-more reports to the Internal Revenue Service and ever-more effort to analyze and understand new tax regulations, more effort in the Student Aid Center to obtain state and federal loan funds for undergraduates . . .

As C.J.A.C.'s January discussion ended, Lawrence Susskind, Assistant Professor of Urban Studies and Planning, raised two issues to which he said statistics would never be responsive: We wish, somehow, to relate cost not to the size of the administration but to the quality of its services as perceived by those who use them. And we should have some better understanding of the quality—or failure—of administration activities.

"No system can be responsive," he said, "if it depends only upon those serving for an evaluation of their services."

The Makers of a New Renaissance on Tour

It was two years ago that the M.I.T. Symphony Orchestra first played in Carnegie Hall, New York, and critic Theodore Strongin of the *New York Times* discovered "a new Renaissance in the making. . . . It was a concert that would have been a credit to a professional orchestra," he wrote in considerable surprise.

The same experience now awaits critics and audiences in five American cities on the most ambitious circuit the M.I.T. Symphony Orchestra has ever planned:

☐ Philadelphia, March 23—Academy of Music, 7:30 p.m.

☐ Dallas, March 24—McFarlin Auditorium, Southern Methodist University, 8:00 p.m.

☐ San Francisco, March 26—War Memorial Opera House

☐ Los Angeles, March 30—Scottish Rite Auditorium

☐ Chicago, April 1—Symphony Hall

The musical program, under the direction of David M. Epstein, Professor of Music, will be the same for each of the five concerts:

—Debussy, *Two Nocturnes*

—Mozart, *E-Flat Concerto for Two Pianos* (John Buttrick, Director of Music, and Robert S. Freeman, Associate Professor of Music, soloists)

—Barry L. Vercoe (Assistant Professor of Music), *Metamorphoses*—five pieces for small orchestra

—Brahms, *Symphony Number 2*

Alumni in each city will be hosts to the Orchestra, and plans for receptions and other activities are now being made. For example, James S. Rumsey, '40, heads a committee planning a reception at the Academy of Music in Philadelphia at 9:30 p.m., following the concert, and many alumni in the Philadelphia area are planning invitations to high school groups and ticket sales to others.

The tour is made possible by support from the Council for the Arts at M.I.T.

Draper: Leadership Changes, but the Leader Continues

Though no one—including himself—can think of Charles S. Draper, '26, as really retiring, Professor Draper will step down as President of the Laboratory which bears his name on July 1, when the Laboratory is scheduled to become autonomous.

He will be succeeded by Robert A. Duffy, Vice President of the Laboratory, who came to M.I.T. a year ago upon retirement as an Air Force brigadier general; his last military assignment was with the Air Force Space and Missile Systems Organization at Englewood, Calif.

David M. Epstein (top), Professor of Music who conducts the M.I.T. Symphony Orchestra, is working just as hard as all his musicians to be ready for the Symphony's most ambitious concert tour in history late in March. With Professors John Buttrick and Robert Freeman as soloists, the Symphony will play in five cities between March 23 and April 1—Philadelphia, Dallas, Los Angeles, San Francisco, and Chicago. (Photos: Marc J. PoKempner)

General Duffy was a special student at M.I.T. in 1952-53, working with Professor Draper—who was then Professor of Aeronautics and Astronautics and Head of the Department as well as Director of the Instrumentation Laboratory, which was later renamed in his honor.

In preparation for final divestment of the Laboratory, Professor Draper, General Duffy, and Albert G. Hill, M.I.T. Vice President for Research, this winter announced additional reassignments for key Draper Laboratory leaders:

☐ John E. Kirk, S.M.'49, who has been Assistant to the President for the past year, has been named Vice President; until July 1, General Duffy carries the title of President-Elect.

☐ Ralph R. Ragan, S.M.'52, who as Deputy Director has headed all Draper Laboratory work for the National Aeronautics and Space Administration, is Director of a newly organized Laboratory Planning Staff.

☐ David G. Hoag, '46, who directed development of the Apollo guidance system, replaces Mr. Ragan as director of all N.A.S.A. work and will also assume responsibility for work sponsored by the U.S. Army.

☐ Roger B. Woodbury, who as Deputy Director has been in charge of Air-Force-sponsored Laboratory work, succeeds Mr. Kirk as Assistant to the President.

☐ William G. Denhard, '42, who has heretofore directed the Laboratory work in inertial gyroscopes and components, is Director of programs for the Air Force.

☐ Laboratory work on gyroscopes and accelerometers will be consolidated under the direction of Michele S. Sapuppo, '52.

The objective of all these changes, said Dr. Hill, is to provide a management structure for Draper Laboratory which will assure its "continuing contributions on the highest scale of technical excellence to the welfare of the nation and the world."

Dr. Draper himself assured the Laboratory staff of what they already knew: "My plans and best wishes are, as always, centered on the Laboratory." He will continue as a member of the Laboratory's Board of Directors and will serve as a consultant in advanced technology.

Final plans for divestment of the Draper Laboratory—from which have come a host of developments in high technology, most of them representing applications of inertial principles to guidance and control—are still being made (*see* Technology Review *for October/November, p. 74*), and further announcements are expected this spring.

Administration: New Assignments . . .

. . . for 14 members of the administration and staff have been announced during the winter:

☐ **Jacqueline S. Casey**, formerly Assistant Director of the Office of Publications, now directs a new unit, the Design Services of the Institute Information Services. The group of which she is the senior officer will provide graphic design and production services for various Institute publications.

☐ **Peter M. Close,** an outstanding middle-distance runner during his undergraduate years at St. John's University, will add the duties of Head Coach of Cross Country and Assistant Track Coach to his continuing assignment as Sports Information Director.

☐ **William A. Davis, Jr.,** who joined the M.I.T. faculty as Associate Professor of Law and Urban Studies last summer, has now been named to direct the Minority Intern Program of the Department of Urban Studies and Planning; it is a federally funded plan for placing 20 minority students from the Department's master's program as planning interns in state and local agencies.

☐ **Derek K. Harps,** who played varsity basketball at Boston University and is now a member of the staff at the First National Bank of Boston, is now Assistant Varsity Basketball Coach.

☐ Gordon V. Kelly, former New England pole vault champion from Springfield College, has been appointed Head Coach of Track and Field, succeeding Arthur E. Farnham who will retire June 30. Mr. Kelly has been Assistant Coach, chiefly responsible for M.I.T. successes in field events, for the past 11 years.

☐ **Susan C. Knight,** formerly Editorial Assistant in the Office of Publications, has taken the post of Editorial Manager in the Institute Information Services; she will have responsibility for editorial work on various issues of the M.I.T. Bulletin—annual reports and General Catalog—and will work with an Analytical Studies Group on a new project to increase the effectiveness of M.I.T. communications.

☐ **E. Ray Pariser,** Senior Research Scientist in the Department of Nutrition and Food Science, is now Advisory Services Officer of the M.I.T. Sea Grant Program. His duties center in public and professional information activities of the Program—including liaison with business, government, and community interests. His previous experience has been in marine and fisheries research and management.

☐ **Dana G. Pond,** a member of the Syracuse University soccer and swimming teams as an undergraduate, has been named Assistant Varsity Swimming and Women's Swimming Coach; he is associated with Allyn and Bacon, Publisher, Inc., of Boston.

☐ **Arnold H. Singal,** S.M.'63, has been named Institute Secretary for Charitable Trusts, responsible for the development of financial support from medium-size foundations and trusts. He has been at M.I.T. since 1968 as Staff Associate to the Institute Estate Secretary and previously was Vice President for research, planning, and development of Federal Distillers, Inc., Cambridge.

☐ **Stewart E. Smith,** Instructor at the Academy of Gymnastics and Perceptual Motor Training, Wellesley, has been named Assistant Coach of Varsity Gymnastics; in 1970 he competed against the Bulgarian national team as a member of the Salukis gymnasts.

☐ **Ronald S. Stone,** '59, Executive Officer of the Graduate School, has been named its Assistant Dean, to recognize his increased academic duties and re-

Continued on p. 86

A Machine For Art's Sake

Don Potts' "First Car" is a work of art sufficiently new in kind so that it is difficult to say anything about it that will be both true and comprehensible. If we say that it is a sculpture which takes the form of an automobile, there are those who dispute its being either automobile or sculpture.

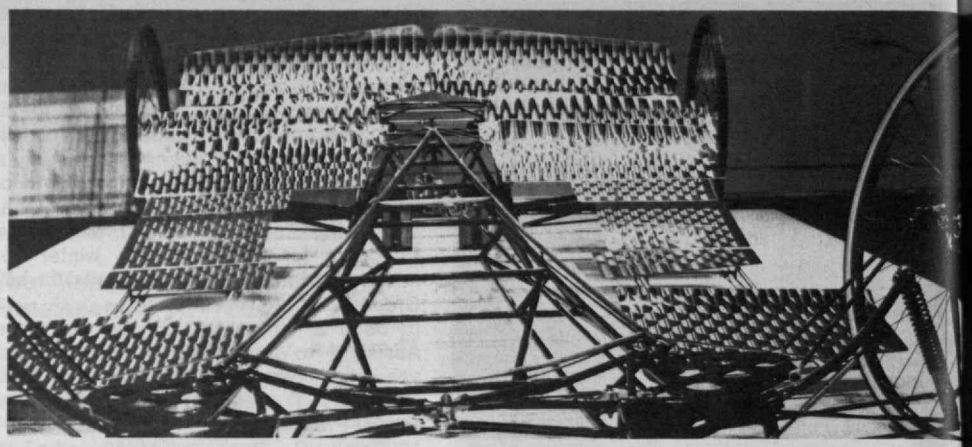
As to its being a car, it is a four-wheeled structure about the size of a small car, steerable, with a suspension of novel design and an air-cooled four-cylinder engine. It has no seats, but has been tested at 15 mi./h. under radio control. "Having proved its operation," it is reported, "Potts no longer wishes to operate it, feeling that the purely technical questions about its operation obscure its true function."

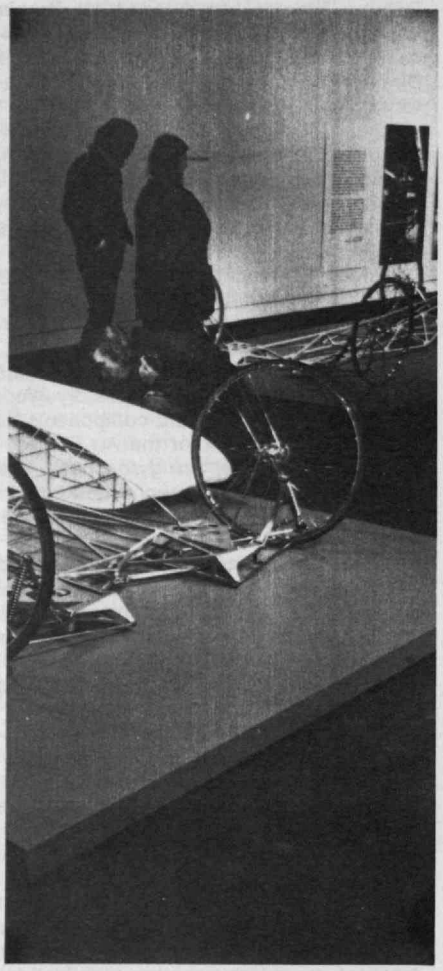
Which is?

Apparently Potts regards the car, and anything else he makes, as a by-product of a process whose main purpose is the development of his own nature. If there is a public which finds such a by-product admirable in its own right—which there certainly is—this is presumably because the state of mind to which the car corresponds is no mere personal idiosyncracy, but is common to an assortment of other human beings. Potts' chosen method of self-improvement is the meditation technique taught by Maharishi Mahesh. His own account of what he is doing therefore uses the specialized vocabulary of that system—thus: "For the artist his art is his most beloved possession because it vibrates the essence of his mantra. Only when the artist has evolved to a point where the whole cosmos becomes his mantra will it be easy for him to give up his work."

One obvious respect in which the Potts car differs from nearly all current sculpture is its outstanding craftsmanship—the craftsmanship, in fact, of a handbuilt exhibition car. It took six years, including the making of a number of special-purpose tools, to complete the four versions of the chassis, two "bodies," and engine-adaptations.

As a student, Potts found contemporary sculpture too easy; it seems that his car is the result of a search for discipline. It may well be that he has discovered a modern equivalent of classical art's physiological realism. Long ago, a sculptor had to make something that both looked interesting and at the same time accurately resembled some recognizable living subject; somewhat analogously, Potts has taken on the task of making something which both looks interesting and also is capable of working like a known type of machine. And the key phrase here is "capable of." The Potts car

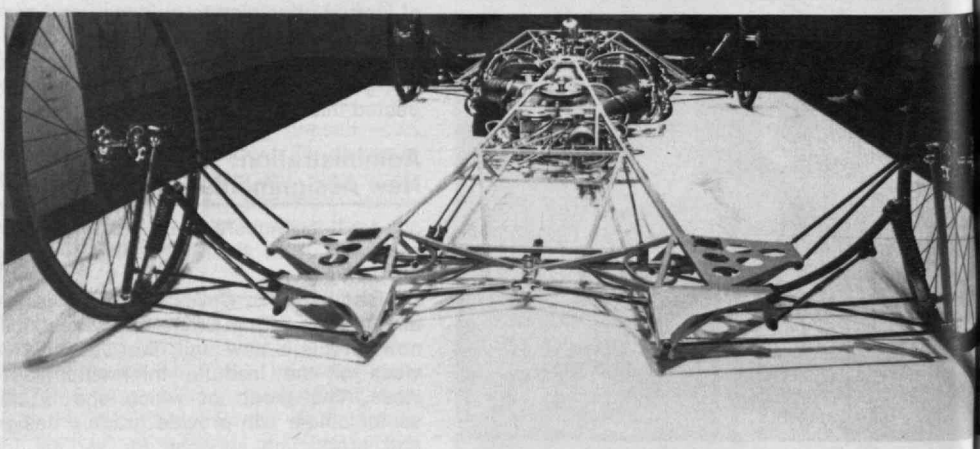


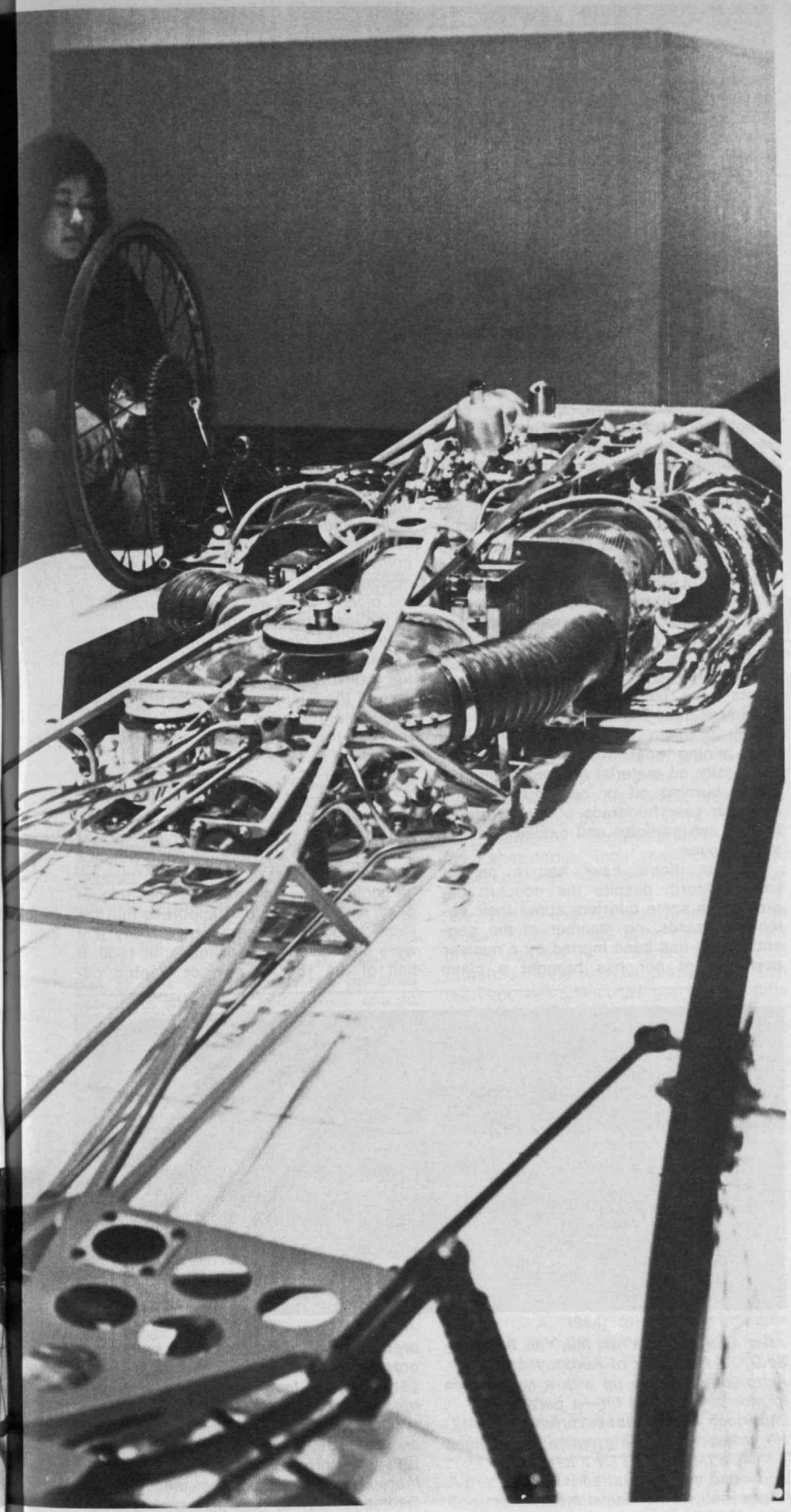


The Committee on Visual Arts was responsible for bringing to M.I.T. last fall an exhibition of visionary cars by Don Potts—and the exhibition in turn inspired the accompanying essay by Fred Wheeler, who was then Managing Editor of Technology Review, *and the following poem, "Potts," by Barry Spacks, Associate Professor of Literature:*

Potts. Potts. Think of the name:
plod-along, pottering Potts: no wonder
he shaped these dreamers' chassis, underslung
polishments of speed, pleasured by
clicks of essential connections, linkage through
silkspun bearings, double-sleeked manifolds,
hand-tooled soapbox-derby guylines
smooth as sexual sleep: effortless
grace of the gods alone, force-
without-sweat, dirtproof power, no pistons
slapping, slam and screech, spatter
of fire and sludge and curses, only
a pure, a boyish intent, a ceaseless
purr to the eye and the bodysense, a
kind of platonic flight, ungeared from our
clattering imperfection where even
Hephaestus has his limp as the badge
of the modesty of the maker, no,
beyond all common sense, becoming
a prettier god, he
hums like Apollo, who
used to go puckatapuckata had to go
potts-potts-potts.

(Photos: David H. Green, '75)





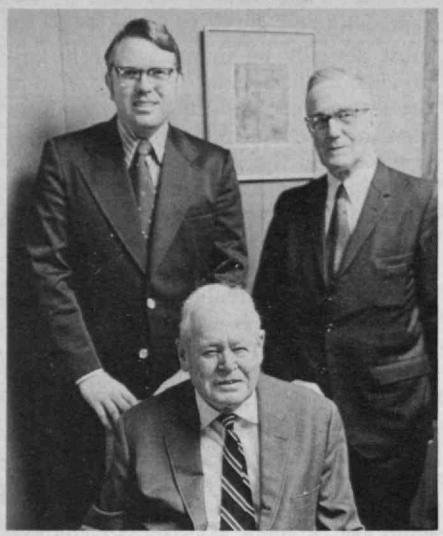
cannot be classed as kinetic art, which must actually be in motion to be appreciated. The point is that, during the process of "sculpting," the requirement of mechanical-engineering soundness satisfies the artist's need for some kind of boundary condition; and it satisfies this often-felt need not in the artificial, arbitrary manner of a man-made set of rules, but in terms of objective, physical realities. "It must behave like a car" is a constraint at least comparable with the classical "It must look like a man throwing a discus."

But is it art?

That, as with the discus-thrower, depends on how one feels about it. When the Potts exhibition opened at M.I.T., the Hayden Gallery featured a woodwind trio playing Mozart. Wayne Anderson, the professor of architecture whose Committee on the Visual Arts was responsible for the show, himself doubts whether the Potts car can be called sculpture, but described the Mozart accompaniment as "an aesthetic decision, if you will—Mozart goes well with the car." Indeed, the car does have a certain 18th-century delicacy. On a 114-in. wheelbase, the steel chassis (with the wheels) and 80-h.p. engine together weigh only 460 lb. Ground clearance is 1½ in. (and, in one version, far less). The general appearance is of a vehicle which has been very carefully optimized for some specific purpose not of this world: for, perhaps, unmanned racing on the salt flats of some low-gravity planet.

The two alternative "bodies" add to this impression. Both are aerodynamic structures which at speed would confer negative lift—one a pair of fabric-skinned stub wings, the other an array of 18 curved steel panels, all but four of which are of variable pitch, motor-driven.

If there is one other artform with which the Potts car might be confused it is the custom car (certainly a real artform, complete with dedication and poverty, as Tom Wolfe explained in "The Kandy-Kolored Tangerine-Flake Streamline Baby"). The difference is that the custom car remains, beneath its imaginative bodywork, a conventionally designed conveyance for human beings. In Potts' car, most of the art is in the chassis itself; Potts also designed his own elegant suspension, and the cooling system for the engine. Only his rather exuberant exhaust piping is reminiscent of the "custom" school of auto artists. For Potts, a machine is neither a subject to be depicted, a substrate to be decorated, or a merely rational thing whose form is dictated by its function: it is a complete medium of self-expression.—*F.W.*



Bruce D. Wedlock, '58 (left), has been named Director Designate of the Lowell Institute School to succeed F. Leroy Foster, '25 (right), upon the latter's retirement as Director on June 30. Beginning at that time, the School will report to the Provost of M.I.T. instead of directly to Ralph Lowell, center, Trustee of the Lowell Institute, and Dr. Wedlock hopes to plan new programs "that will take advantage of the position M.I.T. occupies in the forefront of developing technology." For a modest tuition fee made possible by the Lowell Institute endowment, the School provides evening instruction in technical subjects for men and women working in industry.

sponsibilities in addition to his administrative function.

☐ **William T. Struble,** formerly Director of Publications, has assumed new duties as Managing Director of News Publications in the M.I.T. News Office. He thus has overall responsibility for *Tech Talk, Reports on Research,* and the *M.I.T. Observer.* Trained in science writing at Columbia University, Mr. Struble has had newspaper experience in Rochester, N. Y., and served on the staff of *Technology Review* before joining the Office of Publications.

☐ **Zsolt Szilagyi,** a native of Hungary now studying at the Massachusetts College of Optometry, has been named Varsity Water Polo Coach. A graduate of the University of Oklahoma, he has played club water polo for six years.

☐ **Bruce D. Wedlock,** '58, a former member of the Department of Electrical Engineering who has been with the Research Division of Block Engineering, Cambridge, while serving as Lecturer in Electrical Engineering, has returned to the Institute as Director Designate of the Lowell Institute School to succeed F. Leroy Foster, '25, upon the latter's retirement on June 30, 1973. Dr. Wedlock holds three M.I.T. degrees in electrical engineering (S.B., S.M. 1958, Sc.D. 1962) and was a member of the faculty from 1962 to 1971. He hopes, he said upon being appointed Director Designate, to develop the Lowell Institute School "into a kind of 'graduate school' for people in industry who have associate degrees or equivalent work experience."

Our Nuclear Future

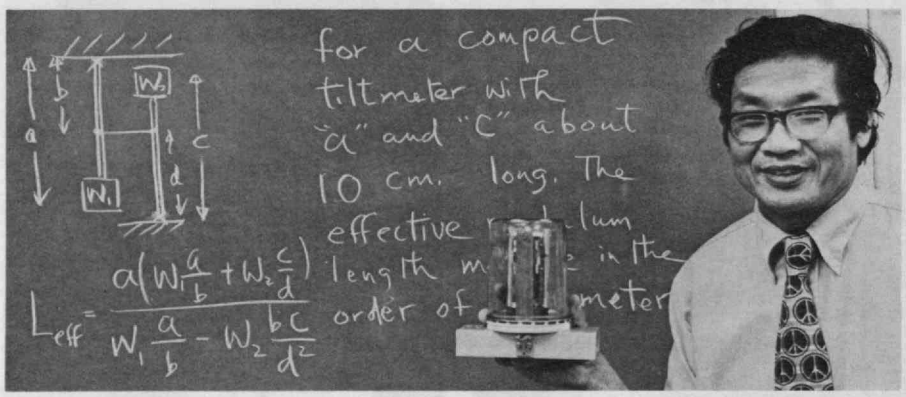
The case for nuclear power was never more enthusiastically put than by Manson Benedict, Professor of Nuclear Engineering at M.I.T., speaking to the M.I.T. Corporation just two weeks after he had been announced to receive the 1972 Fermi Award of the Atomic Energy Commission:

"During the 20 years in which M.I.T. has been active in nuclear engineering, great changes have taken place in this field of engineering. In 1952 nuclear reactors were used solely for military purposes—for producing plutonium or for the planned propulsion of naval vessels. Today, civilian uses of nuclear energy overshadow military. Twenty-eight commercial nuclear power plants generating some 14,000 mw. of electricity are in operation, and 132 more with a total capacity of 130,000 mw. are under construction or on order. In New England 24 per cent of all electricity consumed is generated in nuclear plants. By 1985 the total U.S. nuclear electric capacity is expected to reach 300,000 mw., 80 per cent of present U.S. generating capacity.

"What is responsible for this widespread adoption of nuclear energy for electric generation? Nuclear power is economic; everywhere in the United States except near low-cost coal mines or oil and gas fields, nuclear electricity costs less than electricity from fossil fuels. From the mine to the plant stack nuclear power plants have far less effect on the environment than plants burning coal or oil. Mining uranium disturbs the land less than mining coal. Nuclear plants emit practically no material effluents, whereas plants burning oil or coal put into the air each year hundreds of thousands of tons of ash particles and oxides of sulfur and nitrogen.

"Nuclear plants have had a perfect safety record; despite the concern expressed in some quarters about their potential hazards, no member of the general public has been injured by a nuclear power plant nor has brought a claim against the companies insuring them.

"The rapid growth of nuclear power plants will help our foreign trade balance in two ways: by our export of nuclear technology and by reducing the amount of oil we would have to import to fuel the same amount of generating capacity if it were not nuclear. For example, in 1980, if half of the 150,000 mw. of electric ca-



After a day of work last fall, Yao T. Li, Sc.D.'39, Professor of Aeronautics and Astronautics, came up with a new device to measure ground tilt—a parameter important in earthquake prediction. He stored his working model in a peanut jar while he went off for a long weekend—and then he started thinking: There really is no formal method for giving M.I.T. students ideas about how the process of innovation and entrepreneurship really works. Now he has organized a seminar called "Socio-Technological Innovations" in which he tries "to teach people how to take a worthwhile idea and develop it commercially for real-world use." He uses his ground tilt meter—a device for which there is some demand from the U.S. Geological Survey—as an example of "idea system operation." (Photo: Sheldon Lowenthal from The Tech*)*

Dr. Nevin S. Scrimshaw, Head of the Department of Nutrition and Food Science (center, above), is the first winner of the James R. Killian, Jr., ('26) Faculty Achievement Award for "extraordinary professional accomplishments." He thus holds the title of Killian Award Lecturer—in honor of Dr. Killian, at the left in the picture—and will give two lectures at the Institute this spring. The third figure in the picture is Hartley Rogers, Jr., Professor of Mathematics, who presented the award to Dr. Scrimshaw as Chairman of the Faculty. It was the first presentation of the prize which was the faculty's tribute to Dr. Killian upon his retirement in 1971. (Photo: Marc PoKempner)

pacity now planned to be nuclear were to be fueled instead with imported oil costing 60 cents per million B.t.u., our foreign trade would be adversely affected to the extent of $2.5 billion. . . ."

An "Amateur's" China Report

After more than 30 years, Chia-Chiao Lin, Professor of Applied Mathematics at M.I.T., had an emotional reunion with his homeland in the summer of 1972. He is only an "amateur" China-watcher, he insists, but these were among his impressions:

☐ When Khrushchev withdrew Russian support of Chinese technology more than a decade ago he plunged the country into confusion. Now, having achieved what appears to be substantial independence in high technology, the Chinese are grateful to the U.S.S.R. for forcing them to do so.

☐ The Chinese are everywhere trying to cultivate respect for manual skills. High school courses emphasize this, without turning away from Chinese classics; the whole, he thinks, represents "quite a solid high school education."

☐ University courses, too, emphasize the pragmatic; but the older, classic texts familiar to Professor Lin from his undergraduate days in Tsing Hua University are still in the libraries, honored and used.

☐ In general, Chinese scientists and engineers are working on the same kinds and levels of problems as their counterparts in the U.S. They are well informed: European scientific journals reach China about two weeks after publication, American journals in three to four weeks.

Developing New Resources for Resources Development

Actively assuming his duties as Vice President for Resource Development of M.I.T. (*see* Technology Review *for December, pp. 75-6*), James B. Lampert, S.M.'39, this winter named two principal assistants who have joined with him to take new responsibilities in the Institute's development organization.

They are:

☐ Kenneth S. Brock, '48, who moved from his assignment as Director of the Alumni Fund to become the Institute's Director of Resource Operations.

☐ Nelson C. Lees, '53, formerly Director of the Development Office, who has become Director of Resource Planning.

Simultaneously, the Institute announced formation of a Council on Resources, which will meet as a policymaking and advisory group under the Chairmanship of Howard W. Johnson, Chairman of the Corporation.

Mr. Brock's assignments include coordinating the development staff and organizing relationships between that staff and the various funding prospects; he also is responsible for liaison between development activities of the Institute, the Alumni Fund, and the Alumni Association officers and staff; and he assists Mr. Lampert in administrative matters.

Mr. Lees' assignment is to support the senior officers of the Institute and the development staff with information, records, publications, research and evaluation, and planning; he is Secretary of the Council on Resources.

K. S. Brock, '48

N. C. Lees, '53

Walter S. Owen

In addition to Mr. Johnson, the Council includes Jerome B. Wiesner, President; Paul E. Gray, '54, Chancellor; Walter A. Rosenblith, Provost; Joseph J. Snyder, '44, Vice President and Treasurer; and James R. Killian, Jr.,'26, Honorary Chairman of the Corporation who heads its Development Committee.

These developments represent an extension of the staff and arrangements "ably organized"—the quotation is from Mr. Johnson—during the past ten years by Vincent A. Fulmer, S.M.'53, Vice President and Secretary of the Institute. Mr. Fulmer will now be free to give his full attention to the Corporation and to its expanding system of departmental Visiting Committees.

Mr. Brock, active in student affairs concerned with M.I.T. public relations as an undergraduate, returned to the Institute as a member of the Alumni Fund staff in 1963; in the meantime he had held sales and advertising positions at H. H. Scott, Inc., Workshop Associates, Inc., Browning Laboratories, Inc., and Fenwal, Inc., where he was Manager for Market Development.

Mr. Brock was named Director of the Alumni Fund in 1966 upon the retirement of the late Henry B. Kane, '24, its first Director. In the six full years since then the Fund has gained 57 per cent in gifts and 36 per cent in number of contributors and has won several national awards for successful growth.

It is well on the way to another record this year: at the end of February, the 1972-73 Fund had already received $2,106,901 from 11,706 contributors—a healthy 43 per cent increase in gifts over the same date in 1972.

Mr. Lees has been Director of the Development Office since 1968, where he was responsible for planning, reports, records, and administrative support for the Institute's ongoing development program—including the recently established Council for the Arts. He studied at Columbia (M.A. 1954) following graduation from the Institute and returned to M.I.T. in 1959 for work in the Office of Public Relations.

The Search Ends: Walter S. Owen to the Metallurgy Department

Alfred A. H. Keil, Dean of the School of Engineering, has ended a six-month search for a new Head for the Department of Metallurgy and Materials Science.

The result is that Walter S. Owen, a distinguished British-born metallurgist who is now Vice President for Science and Research at Northwestern University, will come to M.I.T. next July 1.

Meanwhile, Carl F. Floe, Sc.D.'35, will continue as Acting Head of the Department. Professor Floe, who was Assistant Provost, Assistant Chancellor, Administrative Vice Chancellor, and Vice President—Research Administration of M.I.T. at various times between 1952 and 1968, stepped in as Acting Head this fall when Professor Thomas B. King asked—partly for reasons of health—to return to teaching and research within the Department.

Dr. Owen is no stranger to M.I.T. He first came to the Institute in 1951 as a Commonwealth Fund Fellow to work with Morris Cohen, '33, Ford Professor of Materials Science and Engineering. Three years later he was back (1954-1957) to continue work on the physical metallurgy of metal fracture as a member of the Division of Sponsored Research staff.

At the end of this M.I.T. assignment Dr. Owen returned to England to become Wortley Professor of Metallurgy and Head of the Department at the University of Liverpool, where he had studied for his Ph.D. (1950). But opportunities in the U.S. were a strong magnet, and Dr. Owen crossed the Atlantic again in 1966 to become Director of the Department of Materials Science and Engineering at Cornell. Four years later he joined Northwestern as Dean of its Technological Institute and Professor of Materials Science.

Professor King, whose field is the thermodynamics and kinetics of high-temperature systems, first came to the Institute in 1953 after a career in British metallurgical industry and the Royal College of Science and Technology in Glasgow. He became Head of the Department late in 1962.

For Research and Recreation: Five Grants, Nearly $400,000 . . .

. . . were announced at M.I.T. during the winter. They include:

☐ Three-year support from the John A. Hartford Foundation of New York for studies on biochemical and dietary factors in thyroid deficiency, a total of $191,412.

☐ $50,000 from the Rockefeller Foundation for five years of operating expenses for Talbot House in South Pomfret, Vt.

☐ Three grants, a total of over $170,000, from the National Science Foundation

for studies of automobile engine pollution (*see p. 98*), for a short course for college teachers on the Keller Personalized System of Instruction, and under the Foundation's program of institutional grants to sustain collegiate science programs.

Understanding Thyroid Nutrition

Disorders of the thyroid gland are among the most common of the endocrine system; they result in problems ranging from metabolic difficulties to dwarfism, deafness and severe mental retardation. Some arise from insufficient dietary iodine; others have a genetic base. The grant from the Hartford Foundation will help Dr. John B. Stanbury, Professor of Experimental Medicine, and his colleagues in the Department of Nutrition and Food Science try to determine exactly what all this means; Dr. Stanbury is well known for thyroid research.

He explains that goiter—one form of thyroid abnormality—is known to affect many members of a single family. Thus, he says, it is "a genetically determined biochemical disturbance." He hopes that if he and his associates can learn the exact nature of this disturbance they may be able to achieve "an understanding of the nature of thyroid disorders and point a way to their prevention."

A Country Retreat

Four years ago Laurence S. Rockefeller gave his two-story farm house—Talbot House—in South Pomfret, Vt., to M.I.T. as a place for students and faculty to escape from the campus and urban environment for workshops, "think tanks," or just plain recreation. Since then more than 180 different groups—over 3,150 students, faculty and staff—have used it.

Mr. Rockefeller's original gift included operating funds to maintain the house and provide housekeeping and caretaking service for five years. Now he has made a $50,000 grant to M.I.T. to cover operating costs for the next five years. But the Rockefeller support will then end; James R. Killian, Jr., '26, Honorary Chairman of the M.I.T. Corporation, says M.I.T. has agreed with Mr. Rockefeller to assume all operating costs after the current grant expires.

Meanwhile, Jon Hartshorne, Assistant Dean for Student Affairs, and a Talbot House Committee of undergraduate and graduate students is pledged actively to "seek ways to increase its use throughout the year."

Self-Paced Education

When he uses the Keller Personalized System of Instruction and, as tutors, students who have previously completed a course, one teacher can provide personalized instruction to as many as 100 students—that according to Ben A. Green, Jr., of the M.I.T. Education Research Center.

Dr. Green will give a short course for college teachers from June 11-22 in Cambridge, made possible by a $29,959 grant to M.I.T. from the National Science Foundation. He'll explain and demonstrate the system, attributed to Professor Fred Keller of Columbia University, with the assistance of several M.I.T. undergraduates who have used it with him this term.

Institutional Grants for Science

The National Science Foundation had $7.9 million to give in institutional grants this year to help colleges and universities maintain strong academic bases for science, mathematics and engineering. M.I.T.'s share—660 colleges and universities were eligible—was $75,603.

Last year, when the N.S.F. had $11.9 million to divide between 628 schools, M.I.T. received $121,394.

Environmental Engineer

The traditional doctorate in engineering fails in some ways to meet the educational needs of a new decision-maker, who would bring an understanding of environmental issues to government or industry. So thought a committee of nine engineering professors, and one graduate student who had become interested in "environmental education." The doctorate, the committee felt, had too much of a "research orientation" to be attractive to students motivated to work in the environmental field, and that research orientation forced students' interests into a "relatively narrow focus." On the contrary, the environmental engineer's "depth of knowledge in one area must be coupled with significant breadth of understanding across the broad spectrum of environmental problems."

Accordingly, after six drafts and several months, the Environmental Engineer Degree Committee proposed a degree program: the Environmental Engineer, to be granted and supervised by the School of Engineering; and the faculty has approved the new degree to be awarded beginning in June.

Like other Engineer degree programs, the Environmental Engineer degree requires of those who seek it 162 units and a thesis. Of the 162;

☐ 66 must be in a "basic engineering program," two thirds of which must represent graduate level study of basic engineering that will be useful in environmental problems.

☐ At least three subjects (a total of at least 25 units) must be taken from a list of approved "environmental engineering" subjects. The list includes subjects in air quality, water quality, and utilization of natural resources, this last including both materials and energy.

☐ Five subjects (a total of at least 42 units) must be taken from a list that initially includes 13 courses on "environmental policy.

How To Make 210 Stroboscopists . . .

. . . in 80 minutes.

It happpened to that many alumni and their guests on October 18 after an hour of Professor Harold E. Edgerton's special breed of magic at the Lexington, Mass., Motor Inn.

It was the first alumni meeting in more than four years on Route 128, the Boston circumferential highway whose sheen as a base for technologically oriented industry was so darkly tarnished in the late 1960s.

It sounded easy. All you need is a little elastic energy, a capacitor in which to collect it, and a flash tube to convert that energy into light, said Professor Edgerton, who was supposed to retire in 1968 after a career culminating in his appointment as Institute Professor at M.I.T.

"Everything you do in experimental work is generally wrong," Professor Edgerton said—and then proceeded to demonstrate how many different "right" things had been done in a small laboratory on the fourth floor of M.I.T.'s main buildings. The point of all the work, he said, is to enlarge man's vision—"to show you what your eyes cannot see."

"Sensible Scientific Gents"

The students called him "Roxy" Crosby ("He certainly knew his rocks," wrote the late Carle R. Hayward, '04). He first came to M.I.T. as a student in 1871 when the Institute's second President, John D. Runkle, promised him a free pass from Colorado to Boston, free tuition for the first year, and an assistant professorship "with a comfortable salary" in the second year.

Thus begins the story of William Otis Crosby ('76), who served on the faculty of the Department of Geology from 1875 to 1925. He had gone to Colorado with his father in the spring of 1871, learned enough about gold and silver mining and smelting in three months to be recommended by the local miners as a guide for a party of 21 students, four professors, and the President of M.I.T. in July. He found the President's offer irresistible and the Boston visitors "by far the most sensible set of scientific gents I have seen for some time."

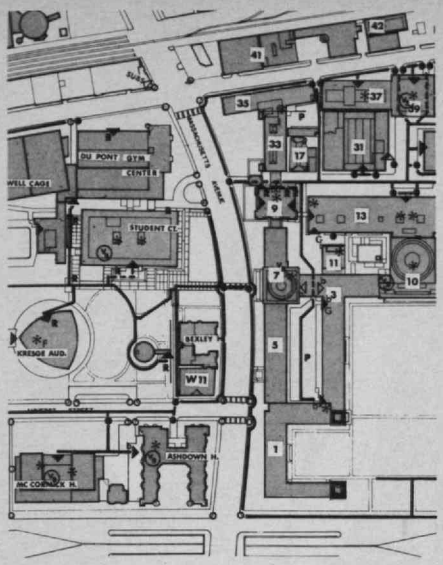
Of two sons, only one—Irving Ballard Crosby ('17), born in 1891—survived infancy; trained as much by his father as by M.I.T., Irving spent all of his professional life as an independent consulting engineering geologist.

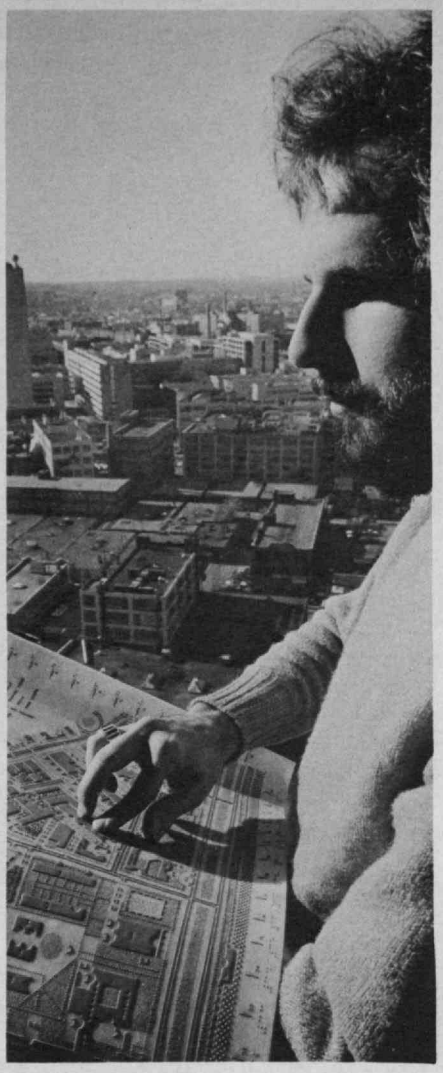
The story of both Crosbys is now told by Robert R. Shrock, former Head of the M.I.T. Department of Geology, in a book which is in effect an expanded chapter of the history of geology at the Institute which is Professor Shrock's current project. Perhaps the most interesting part of the account is the verbatim reproduction of Professor Crosby's journal of his travels to and in Colorado in 1871. Copies of "The Geologists Crosby of Boston" are available from the author at M.I.T.; its publication was made possible by the late Thomas C. Desmond, '09.

M.I.T. By Wheel Chair? No Way; How About If I'm Blind?

You are blind—or at least blindfolded. Enter an elevator (how you found it does not matter to this story). Someone presses a button for your floor. The doors close, the car moves, then the doors open. Your floor? Someone helps you, by saying no. The car moves again. This time the stop is yours.

Or you are crippled—or at least you are in a wheel chair. How to go from taxi to classroom? Stairs here. A heavy door





This "highway" map of the M.I.T. campus is for operators of wheel chairs, to show handicapped campus visitors how they can find their way through a campus that has nearly as many levels as it has buildings. O. Robert Simha, M.C.P.'57, Director of M.I.T.'s Planning Office, urges the need for special circulation systems for the handicapped superimposed on the campus circulation systems the rest of us use. A more complex campus map (right), described in Technology Review for January, page 63, has been prepared for the blind; in the picture Michael L. Lichstein, an M.I.T. graduate student in economics, demonstrates its use standing on the roof of Eastgate, from which he can "feel" the campus as others see it. Manufacture of the map depends upon a proprietary process of Plastic Lace, Inc.

there. A ramp to an entrance and an elevator way down at the end of the parking lot . . . the only way from Massachusetts Avenue into the main M.I.T. buildings.

These represent problems that few campus planners ponder in the press of the important issues of design, space, circulation, and security. But the problems of the handicapped are finally getting attention: blind students at M.I.T. now have a map of the campus *(see* Technology Review *for January, page 63)*, and the handicapped have a guide to the circuitous routes along which wheel chairs can be maneuvered.

Studies continue. An elevator in M.I.T.'s Ford Building has bells and buzzers—bells to warn a blind user that the door is opening or closing, a buzzer which sounds as the car passes every floor, so the blind traveller can count his progress. Control panels in all Ford Building elevators are fitted with numbers in braille beside the buttons to which they refer.

These several experiments mark the first stages of a program to eliminate architectural barriers to the handicapped throughout the M.I.T. campus and to study what devices and information are most needed to make the campus accessible to them. The effort, led by the M.I.T. Planning Office, has involved the expertise and help of countless other groups—the Sensory Aids Evaluation and Development Center, the School of Architecture and Planning, the American Foundation for the Blind, the Howe Press of Perkins School for the Blind, the Dean for Student Affairs, the Medical Department, and others.

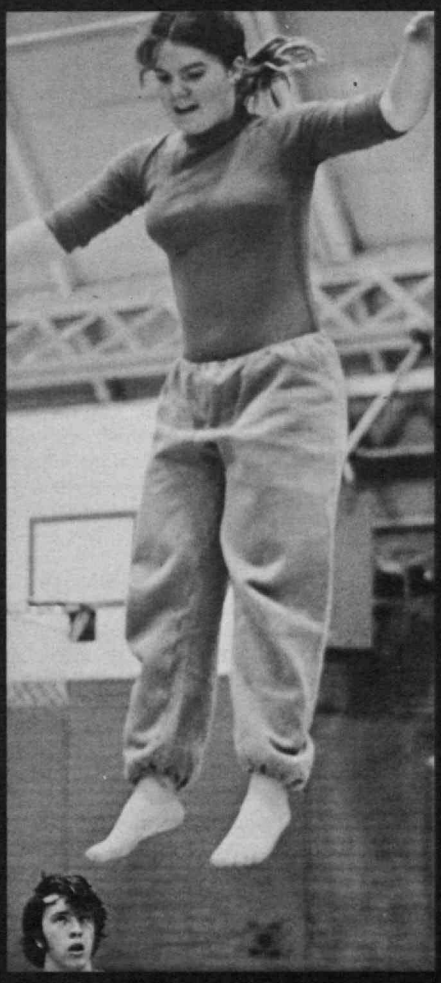
What comes next? O. Robert Simha, M.C.P.'57, Director of the M.I.T. Planning Office, has a long agenda for testing and implementation: continuing efforts to eliminate curbs and build ramps for wheelchairs. Special door hardware more easily used by the handicapped. Putting telephones, elevator buttons, even light switches lower, where they are more easily reached from a wheel chair.

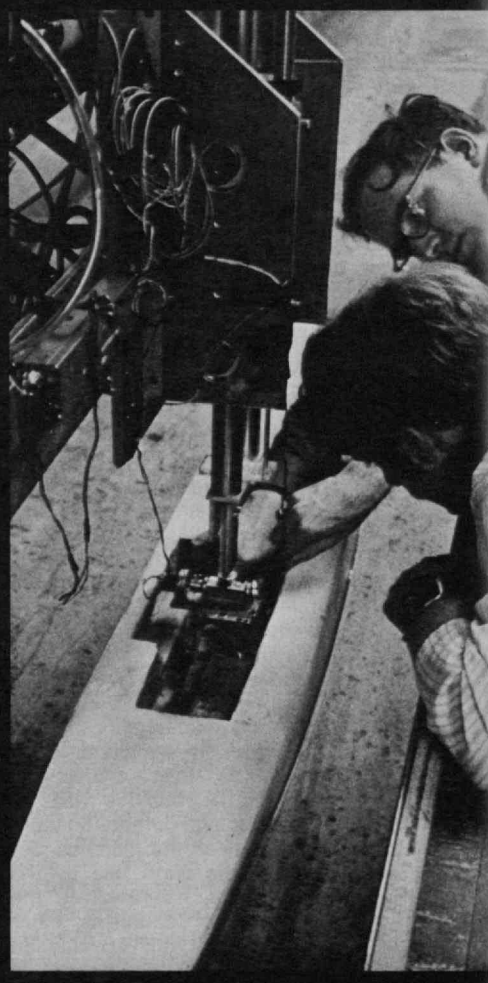
For the blind, how about a tape recording which can be played as you hold the three-dimensional M.I.T. map? Electronic "guideways" which tell, with a tone from a small radio receiver, how to proceed from one M.I.T. building to another? A braille campus directory to give building, room, and telephone numbers of important destinations? A braille edition of "How to Get Around M.I.T.," and a recorded text of the "Guide to M.I.T. Libraries," and a special resources center for blind library users in the Student Center Library—all projects of a committee of the M.I.T. Libraries staff.

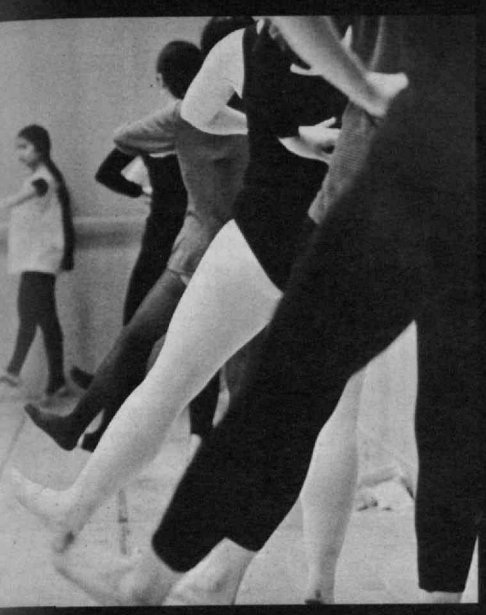
All these things are only a beginning, thinks Mr. Simha; now that the blind can begin to move independently through the campus, they need a series of back-up systems to help the map work for them.

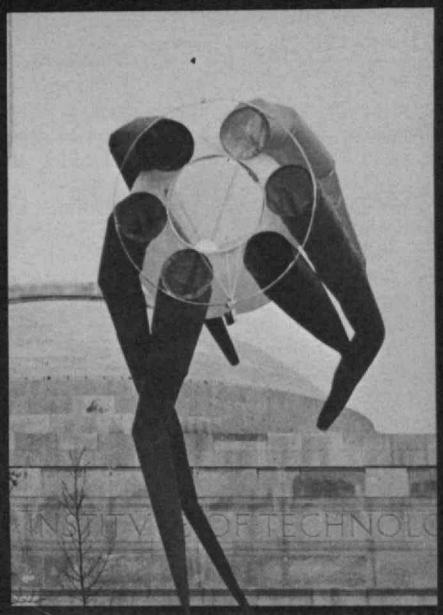
The Gallery

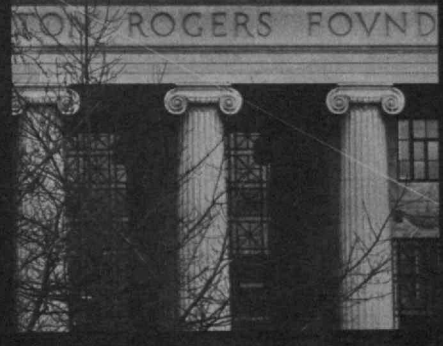
"If only you didn't have to go to classes, you could do some learning." During Independent Activities Period—the month of January—that lament is impossible. It's a time for indulging one's curiosities, "an occasion for professors to speak of things they do not understand." I.A.P. "is most emphatically not *a waste of time," says* The Tech. *Scenes this year: glassblowing, machine shop, building a foam house, ship model testing, elementary skating, a workshop on self-paced study, Chinese dance, trampoline, pottery, figure drawing, gymnastics . . . (Photos: Margo Foote, Sheldon F. Lowenthal, '74, and David H. Green, '75)*







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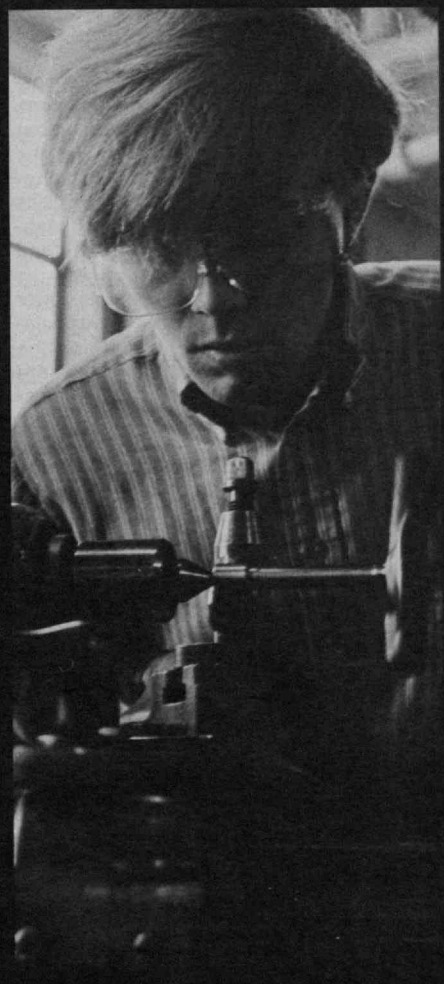

"On December 20, There Will Be No Tomorrow"

So began an open letter to the M.I.T. community from the Committee to Save Ashdown Dining. "On that day," the letter continued, "the Institute plans to close Ashdown forever."

Almost the truth. The M.I.T. administration had resolved to close Ashdown's dining hall—not "forever," but "indefinitely."

Ashdown House is a graduate residence. It was a hotel decades ago, which perhaps accounts for a certain elegance in its dining hall, which is wood panelled, and divested of mausoleum ambience by archways, columns, and bay windows that seem to divide it into alcoves. The views through the large, many-paned windows are of the Charles River or West Campus, discreetly screened by greenery.

Ashdown's dining hall is one of three on campus that served *a la carte* meals (in the others, students purchase term-long commons contracts). It is widely held that the other two *a la carte* facilities are not quite as pleasant.

☐ Despite its abundance of windows that provide a view of Massachusetts Avenue and the Building Seven edifice, the atmosphere of Lobdell, in the Student Center, is still forbidding—not, perhaps, like the atmosphere of a box wherein B. F. Skinner's pigeons joylessly consume food pellets, but the Committee to Save Ashdown Dining likened it to a "bus terminal."

☐ Across campus, in Walker, the atmosphere is a curious one for dining. The Medieval hall features huge Romanesque murals—in fact, there is a triptych on the wall separating the dining hall from the serving area where diners load their trays with food. On two opposing walls of the dining hall, naked cherubs heft olive branches and gentlemen and ladies arrayed in robes extend their arms toward some no longer decipherable beatific vision in the faded heavens. Columns line the other two walls. The floor is of the cracked terrazzo pattern common to old municipal buildings. The Committee gave it a "museum atmosphere . . . not conducive to congenial conversation."

"Walker and Lobdell will remain open," lamented the Committee's letter, "providing a place for the consumption of food . . . You enter, eat, and leave, many times without speaking to the person across the table." Ashdown dining, on the other hand, was "perhaps the only regularly occurring event where graduate students and the M.I.T. community can meet and talk."

The letter closed by urging people to sign a petition, write a personal letter to the President and Chancellor, come to a faculty meeting on Wednesday, November 15, 1972. As an experiment, the agenda of that meeting was to be open-ended; discussion could be initiated from the floor, while normally topics of discussion would be offered for inclusion in the agenda of the next faculty meeting, a month away.

Stewing About the Problem

If there is any truism about the management of M.I.T., it is that the administration tries to be seldom surprised. When, under the open agenda experiment at the faculty meeting, a few defenders of Ashdown rose, the administration was prepared.

Richard M. Dudley, Professor of Mathematics, understood and appreciated the noble efforts being made to keep costs down. Yet the application of nobility and self-sacrifice to Ashdown's dining hall was not right. He hoped the administration would "reconsider their very effective deficit-management program, and manage it in another area."

"Chancellor Gray has been stewing, if that's the right word, about this problem for some time," responded President Jerome B. Wiesner, and Chancellor Paul E. Gray, '54, rose and moved toward a microphone, holding a sheaf of papers. The numbers on those papers constituted a dismal story. To summarize:

☐ In total, Walker, Lobdell, and Ashdown can serve 3,500 people at any one meal. In fact, according to Dr. Gray, the *a la carte* dining system serves about 500 breakfasts, 2,500 lunches, and 700 dinners.

☐ Ashdown is the smallest of the three facilities, both in capacity and in sales volume. Closing it, rather than one of the others, would leave two large facilities, one on each side of the campus.

☐ Ashdown's loss as a percentage of sales is largest—17 per cent last year, while its two larger brothers managed losses below 10 per cent of their sales volume. Even invoking accounting methods to "reduce" losses by injecting money from employee benefits and pinball machine revenues, Ashdown's losses drop to about 9 per cent of sales while the other facilities' losses, after this cosmetic accounting, drop below 4 per cent.

☐ If Ashdown is closed on December 20, between that date and the end of the academic year in June, costs will be reduced about $36,000, of which $16,000 is M.I.T.'s net savings. Residents of Ashdown will save between $2,000 and $3,000 on their house bills.

☐ The future does not seem to offer failing Ashdown any aid, for the population of Ashdown will be halved for the next two years. Massive renovations are to be conducted, which will require closing first one wing and then the other of the two-branched building. These renovations would also make life "awkward" for both diners and construction workers.

☐ Ashdown's kitchens are sufficiently decrepit so that *they* would need renovating, were Ashdown to continue to serve food. In fact, said Dr. Gray, kitchen renovations would be required to "bring it up to reasonable standards of safety—not health but safety."

No Subsidies?

Chancellor Gray invoked a guiding principle by which onerous decisions like the Ashdown closing are made. There should be no subsidies, said Dr. Gray: Student housing and dining have always been expected to break even; those who benefit should be those who pay.

The opposition could immediately think of two matters that involved either subsidies or losses of money far more spectacular than Ashdown dining's.

☐ Northgate Community Corp., formed by M.I.T. to acquire and operate real estate in Cambridge and accused by radical groups of attempts to evict the poor, unfair exemption from rent control, and lead-painted apartments. The first two accusations are argued; the last, at least, has been proven true. At any rate, Northgate has been an unpleasant business for M.I.T., which claims to have lost $200,000 on it last year. "It was not planned that way," said Dr. Gray. M.I.T. is trying to get rid of Northgate.

☐ The Faculty Club? A decade ago, said Dr. Gray, "the decision was made to regard the Faculty Club as an employee benefit" rather than as a club in a strict sense, whose members (faculty, teaching staff, and administrative staff are eligible) would pay dues. Losses above the amount that would be offset by employee benefits were not planned for, either; now that they have happened, "we are moving to reduce that loss."

The Need Must Be Answered

Suhas Patil, Assistant Professor of Electrical Engineering, Assistant Director of Project MAC, Ashdown resident, rose. Some of the numbers he offered were challenged. But some of his arguments were troubling. If few students took out commons contracts at Ashdown, he said, that was because of the work habits of graduate students, who often undertake Herculean work shifts on their research and at very least cannot be certain of being free for lunch at a given time daily. *A la carte* service is very valuable to them. He touched on Ashdown's pleasant atmosphere and its opportunity for faculty and graduate students to converse over lunch.

A few years ago, said Professor Patil, M.I.T. spent about $100,000 redoing the entrance to Ashdown, putting up new vestibules and revolving doors, and landscaping the entrances. This, said Professor Patil, "is rather odd."

Where, he asked, are we heading? If we are to truly break even on dining, what of the two large halls that will remain open? They do not break even. Shall we close them? "You might suggest that machines are the best way to feed man," said Professor Patil, referring to the vending machines that live in the caverns beneath M.I.T.

We have to communicate, he declared. "That need must be answered."

Professor Patil then proposed a motion to ask that the Committee on Student Environment study matters, and that the administration not take any action until that Committee reports to them. The administration would set a time limit for that report's completion.

The Aesthetics of Peanut Butter and Jelly

Chancellor Gray returned. Personnel problems prohibit dallying with the time of closing, he said. That is no way to conduct labor relations.

On the matter of renovating student dormitories, President Wiesner had some thoughts. He recalled that the Student Center was designed with much student consultation, yet it is the most-com-

Elegant dining: Lobdell, in the Student Center, expected to serve Ashdown's former customers. (Photo: Marc Po Kempner)

plained-about building on campus, and students are the complainants.

Residents of a building and the building's owners often find different sorts of renovation desirable. M.I.T. chose to spend its money repairing Ashdown structurally, rather than making it a more luxurious dwelling. "If the administration could have found a way to preserve that structure with mirrors, we'd have done it." But "we're very close to the edge" beyond which no amount of maintenance can save the building for future students.

And on the $100,000 spent a few years ago on the architectural equivalent of face-lifting: "I don't think it's fair to rub our noses in that." The previous administration bought that, and when they did, "$100,000 didn't seem like so much."

When, a few years ago, construction of new student housing was undertaken, it was done with some trepidation. Now, said Dr. Wiesner, we wish we had twice as much. So problems of providing adequate facilities are elusive, defying our best guesses. But the closing of Ashdown's dining hall is not irreversible.

The problem of a decent environment for students is one that troubles Dr. Wiesner, and, he said, it is not simply a debate over the closing of one dining hall: "Peanut butter and jelly, which I am told is standard [student] fare, is neither very good, nor aesthetic."

They Don't, and We Do

There were more questions. Should M.I.T. investigate restaurant management techniques? No, said Dr. Gray, for dining facilities are not run like restaurants; dining hall employees receive M.I.T. employee benefits. Does the vending machine company make money? That went unanswered at the meeting. (In fact, it does not; it is bound by contract to serve M.I.T., but in most machine locations, it loses money. These losing machines are left unserviced, and are usually vandalized.)

Faculty remarks continued, one from a professor who identified himself as a previous Chairman of the Committee on Student Environment and remembered an evening he spent eating at a student dormitory. "Horrible!" he exclaimed. "That was not a dining hall!" The professor said that the torture chamber in which he had dined was in the "s-shaped" dormitory, which he said was Burton House.

The s-shaped House is Baker.

Someone else said he did not think the Committee on Student Environment could do anything in the way of obtaining new information before the closing date.

Dr. Gray seemed inclined to agree. "I am not happy with the suggestion that the thing has been looked at in a haphazard way," he said.

And Dr. Wiesner told the faculty that the decision on Ashdown was a financial one, and hence the responsibility of the administration. A faculty resolution would not be binding.

The students' petition had collected some 1,200 names. "If just half of these people would patronize Ashdown House, we wouldn't have a problem," Dr. Gray concluded. "They don't, and we do."

In this ambiguous atmosphere, with no one at all feeling very pleasant, a motion was amended and passed by a vote of the faculty who remained (65 had been present at the outset). Here, according to the minutes of the meeting kept by the Secretary of the Faculty, is the wording of that motion:

"Moved that the Committee on Student Environment consider the issue of the Ashdown dining room, consulting with the representatives of the faculty, graduate students, and the administration as necessary, and make appropriate recommendations to the administration. That the matter of reopening the facilities of Graduate House be left open until after the report of the Committee on Student Environment."

It was 5:35, Dr. Wiesner told the faculty; but apparently they knew that, for without a motion for adjournment, they bolted. Dr. Wiesner remembered the open agenda. "I suppose this has been a successful experiment," he told a rapidly emptying room.

Coincidentally, the next faculty meeting was held on December 20. On that day, Ashdown's dining hall closed. Though there was no open agenda at this meeting, it lasted until 6 p.m.

(Considerably past our deadline, an article by Howard D. Sitzer '76 has appeared in *The Tech* under the headline, "Ashdown Future Optimistic." Two paragraphs in, one realizes that it is the chairman of the Committee to Save Ashdown Dining who is optimistic, feeling that the M.I.T. administration is sure to approve a plan to serve fewer entrees and the previous day's leftovers at a reopened Ashdown.

Massachusetts Institute of Technology

TECH TALK

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Nixon Names Wiesner Science Advisor

Presidential Press Officer Ronald Ziegler announced in Washington this morning the appointment of MIT president Dr. Jerome B. Wiesner as Special Assistant for Science to the President. The announcement was made simultaneously in Cambridge by the Chairman of the MIT Corporation, Howard W. Johnson, who also announced the appointment of Chancellor Paul E. Gray as acting President of MIT, pending approval of the MIT Corporation.

Dr. Jerome B. Wiesner

In the Washington announcement, Mr. Ziegler noted that "this appointment should show that this administration still places a high priority on science and technology. Dr. Wiesner is a distinguished member of the academic community, and although we have not seen eye to eye on every issue, his opinion, and through him, the opinions of the American scientific community will be given serious consideration."

The announcement described changes which will be made to convert the "Presidential Science Advisor" into the "Special Assistant to the President for Science." The Presidential Science Advisory Committee and the Office of Science and Technology will be disbanded, and most of the science staff of the executive branch will be moved to the National Science Foundation.

The new Special Assistant for Science will be in charge of collecting and summarizing scientific opinion for the president, and will be expected to call on the NSF and other federal agencies, as well as private industry, for information and assistance, rather than relying on professional staff or advisory committees, according to the announcement. "This new system," Ziegler said, "will reduce or remove the narrow range of opinion which reduced the validity of former science advisory systems."

Chairman Johnson released the same announcement in a press conference in 9-150 this morning, and added "Clearly, the rumors of a decreased role for science in public policy have been false. All of us at MIT will miss Dr. Wiesner's extraordinary vision and talent for innovation. He is the right man for these times, as is Paul Gray, who will now be asked to lead MIT alone."

Chancellor Paul E. Gray

Dr. James R. Killian, Jr. Honorary Chairman of the MIT Corporation told the press conference that "Dr. Wiesner has made extraordinary contributions to the development of MIT as a great national institution. Our confidence at the time of his selection has been rewarded, and we congratulate him on a job well done. In addition, let us all offer a helping hand to the man who will soon be President alone, Paul E. Gray. (Dr. Killian is, himself, a former presidential science advisor, having served under President Eisenhower. Dr. Wiesner served previously under Presidents Kennedy and Johnson.)

Because of their past differences Dr. Wiesner said he was surprised last week when the President asked him if he would accept the new post. "I have not been to the White House in two years, since a panel on the ABM, which I opposed. Then, last week, President Nixon called and asked

(Please Turn to Page 4)

MIT Astronomers Discover New Star

MIT astronomers have announced the discovery of an important new nearby star in the heavens. This is the second scientific coup within a month (the first being the confirmation of the existence of water-ice on the major moons of Jupiter) for a group led by MIT astronomers.

Writing in an article to be published in the upcoming issue of **Scientific American**, the team says: "We have conclusively identified the presence of a previously unknown stellar object."

The scientists of the group are: Roger G. Whitman, on leave from the MIT Department of Earth and Planetary Sciences; F. William Harris, MIT Department of Physics; John P. McGrath, Department of Astrophysics, Cal Tech; Robert K. Richardson, Department of Astrophysics, Stanford; and Stephen Manning, a specialist in sky survey techniques on loan from the Kitt Peak National Observatory.

An innovation made by Professor Whitman and Dr. Manning led to the discovery of the star. Old scanning techniques often used a device called a blinker microscope to discover stars with a large apparent motion through the background of "fixed" stars. Two plates are taken of a region but separated in time by anywhere from one to forty years. These are placed in the blinker, which acts somewhat like an alternating stero viewer, and any star which has moved in comparison to the others is seen to flash. Stars found by this method are important as their large apparent motion indicates that they are either very close to us or moving very rapidly relatively or both.

However, the Manning-Whitman technique greatly reduces the necessary delay between exposures and the tedium of scanning thousands of plates. The images are sensed by a special recorder which is hooked to a computer. In this very powerful method, which also utilizes the extremely high resolution capabilities of Very Long Baseline Radio Interferometry, the computer compares the digital representatives of two scans taken as little as a week apart. Under the ULBRI system, it is possible to detect the movement of a nearby star if it exceeds only one stellar radius. Professor Whitman predicts that "the technique will have a tremendous impact on astroscience."

The article goes on to explain several extraordinary aspects of the newly discovered object. "In this instance, we found not only a high velocity star, but also one which had previously been unknown. The star was undoubtedly much dimmer in the past, but we believe that a recent flareup, which resulted in an increase in intrinsic brightness of at least several orders of magnitude, has caused it to become visible to us."

The investigators report that the star is believed to be the closest such object yet discovered. Until now, the nearest star was thought to be Proxima Centauri, a member of the trinary Alpha Centauri system, at a distance of about 4.2 light years (or some 25,000,000,000,000,000 miles).

"In fact," the article continues, "the star is so close to earth as to show an actual disk to the careful naked-eye observer. Due to its recent flareup, the radiation effects of which have not yet been analyzed, it is actually so bright as to be visible during the day. Our discovery was made at a daylight test run of our equipment during one of the few breaks in the nearly perpetual overcast of the past few months.

"The star is presently to be found in the constellation Acquarius, but due to its exceptionally high tangential velocity it is moving toward Pisces. We have not yet considered the subject intensively, but it has been generally agreed to name the star after the day of the week on which it was first seen, the date being January 7, 1973.

"Arguments have been offered as to the mechanism by which

(Continued on page 5)

Faculty to Meet

The MIT Faculty will hold its regular February meeting in Room 10-250 starting at 3:15 p.m. Wednesday, February 7.

The first portion of the meeting, open only to members of the administration, will focus on a motion by the Committee on Faculty on the granting of certain professorships.

Following this first item of business, the doors will be opened and all members of the MIT community are invited to attend the rest of the meeting.

The agenda includes reports from the Pounds Panel on the Special Labs, the Study Group for MIRV at MIT, the Commission on MIT Education, and remarks by General James B. Lampert on development of MIT. The meeting will conclude with the departure of faculty members from the room.

Special

Due to the importance of the appointment of Dr. Jerome Weisner as President Nixon's new science advisor, TECH TALK will appear this week on Monday instead of Wednesday. Regular Wednesday publication will resume next week.

Cover Subject

Howard W. Johnson, Chairman of the MIT Corporation, will be the subject of a cover story in the February 16 issue of **Business Week**, featuring his work as Vice-Chairman of Federated Department Stores.

OFFICE OF THE CHAIRMAN OF THE CORPORATION

To Members of the MIT Community:

After three long years, I am happy to announce that MIT has completed negotiations with Federated Department Stores of Chicago, Illinois, for the construction of a 31.00 million dollar shopping center on MIT property formerly owned by the Simplex Wire and Cable Company.

As you know, we stated at the time of the Simplex purchase that the Institute should favor prospective commercial developers who indicated a willingness to cooperate with both MIT and the city in terms of achieving the social and environmental objectives We felt at the time that this was an appropriate course of action.

We now feel that the objectives set down three years ago have been fully met by the terms of this agreement, which allows maximum flexibility for MIT.

Scattered portions of land have already been purchased to round out the existing plot, and to provide 25 acres of parking; these purchases have been MIT's way of contributing to the creative renewal of Cambridge's urban crisis.

Through the negotiation period, we actively sought multiple inputs to the decision-making process from responsible spokesmen, including members of the MIT administration, their close personal friends, and residents of the Northgate community.

Construction will begin this spring; the expected completion date is fall of 1975. Current plans call for the complex to include Filene's, business and professional offices, the Harvard Coop, Gnomon Copy, and a 28-Flavor ice cream parlor.

I think all of you have reason to be proud of this newest service to the city of Cambridge; it should open new avenues of communication with the city at large.

Howard W. Johnson

"You've Been Had! It's a Hoax!"

Anything that can be believed is an image of the truth—a good standard for effective satire, and one *The Tech* chose to follow when some of its staff members began to think about the issue of *The Daily Reamer* to be published on second term Registration Day this year.

The *Reamer* began some years ago, apparently as a response by *The Tech* to the ne'er-do-wells who published the humor magazine *VooDoo*, and it has lived through an age in which nothing whatever seemed very funny on the campuses, an age that killed *VooDoo*. The *Reamer* has persevered, though it has tended in recent years toward the scatological.

This time around, the reamers turned their thoughts to *Tech Talk*, M.I.T.'s "house organ" weekly official newspaper/calendar.

It took two and a half weeks to produce the lead story on the appointment of M.I.T. President Jerome B. Wiesner as President Nixon's science adviser of sorts. In a concatenation of reality and fantasy, the writers assumed that the position of Presidential Science Adviser would metamorphose (actually, Nixon had just abolished it) into the "Special Assistant to the President for Science," and the Executive Branch's Office of Science and Technology would be incorporated into the National Science Foundation (the O.S.T. has also been abolished; the N.S.F. will not take its place). At M.I.T., Chancellor Paul E. Gray would, in the words of Chairman of the Corporation Howard W. Johnson, "now be asked to lead M.I.T. alone" as Acting President of the Institute.

That lead story jumped to page three, where it concluded soberly with biographies of Drs. Wiesner and Gray.

Page one of the hoax was perfect; we've reproduced it on the facing page. But those who believed the Wiesner story—and quite a few did—couldn't have looked very hard at the rest. For past the first page, the illusion broke down, and rather rapidly. On Monday February 5, there would be a demonstration of a fission device on Briggs Field; bring your own marshmallows. On Tuesday, a field trip sponsored by the Earth Sciences Department to Cape Cod to watch the continents drift apart. On Wednesday, Senator George S. McGovern would speak on the topic, "So You Want to be a Politician?" The time: 4 a.m. "Community Meetings" would include, on Thursday, a poetry reading of works composed by M.I.T. administrators during "The Time of Troubles." Vice President John M. Wynne's favorite:

All of you
here
are trespassing,
leave in five
minutes,
or you will be under
arrest.

Worse yet. The Secretary of Labor had condemned all Institute buildings and dormitories for non-compliance with the Occupational Safety and Health Act of 1970. Slam Van Dong, Assistant North Vietnamese Negotiator at the Paris Peace Talks, was to become Arnold Findel Lecturer in International Politics at the Institute. Effective February 1, the Emergency Sex Information Office telephone number will be changed from—

When the press run was completed, at 3 a.m. on Registration Day, February 5, *Daily Reamer* staffers delivered copies to A.P., U.P.I., and several Boston radio stations, then deposited stacks of the bogus *Tech Talk*'s at the registration area at M.I.T., and waited.

At 10 a.m., radio station WBZ, fooled, ran the Wiesncr story on a news broadcast. Throughout the morning, congratulatory calls came in to Dr. Wiesner's office. At 11:30 a.m., Robert M. Byers, Acting Head of M.I.T.'s Institute Information Services, called WBZ; WBZ hadn't called him, or anyone else, to check the accuracy of the story.

"You've been had," said Mr. Byers in his best Spencer Tracy style. "It's a hoax."

The Little Orange Best-Seller

The local best-seller is a 60-page orange booklet, available free.

The price has less to do with its success than the title: "Sex."

For some readers that may be misleading; this 60-page booklet is really a handbook intended for quick reading by students who are in some way "hung up" with questions about a subject in which their experience and information may be inadequate to their aspirations. "The best we can hope to do," the book says, "is enlighten just a bit, perhaps dispel a few myths . . ."

"Sex" has been edited by a group of faculty, students, and Medical Department staff from a manuscript originally prepared by the Planned Parenthood League of Massachusetts; it can be distributed free to M.I.T. students who ask for it thanks to financing by the Dean for Student Affairs and the Graduate Student Council, among others.

In a letter which goes with every copy distributed in the M.I.T. community, Carola B. Eisenberg, Dean for Student Affairs, explains: "Sex is a part of life, a part which—particularly during late adolescence and early adulthood—takes on special importance for human happiness and—unfortunately for some—human unhappiness."

Dean Eisenberg's staff emphasizes that "Sex" isn't on display and "will not be imposed" on anyone. The book, too, emphasizes its readers' freedom: "Only you know whether you feel confident enough to pace your own sexual life not according to parental dictates, or pressure from your peers to perform, but according to your personal needs and the development of a relationship.

"Whether you decide to participate or to hesitate, try to understand the reasons for your decision. . . . Trying to conform to someone else's standards, whatever they are, is a sure way of becoming miserable and frustrated."

Perhaps the most important conclusion *not* to draw from this book is that sex is the only important goal of human existence.

The ceremonious beginning of the 1972-73 M.I.T. Intramural Ice Hockey season. Above, a staged face-off before the first A-League game. Below, Baker House A goalie Dirty Ed Markowitz, '70, his not quite razor-sharp right skate poised above a rope stretched across the goal. (Photos: Krishna M. Gupta)

Savagery on Ice

It seemed appropriate to do something ceremonious, it being the first A League game of the M.I.T. Intramural Ice Hockey season. Accordingly, a length of rope was tied across a goal and Baker House A's goalie, "Dirty Ed" Markowitz, '70, told to sever it with his ice-skate blade. The blade was dull; the rope was thick. Dirty Ed dutifully sawed away, but soon became entangled.

The abortive ceremony went largely unnoticed. The players on ice practiced their slap shots, while the spectators idly wondered what was happening at the goal to delay the start of the first period. When play began, the game proved to be a curiously sluggish one. A League play looked like C League, complained a fan.

But if A League played like C, C League played that evening like vaudeville. Arrayed in yellow "Burton Bombers" sweatshirts, a team effort mounted by Burton House's third floor met with a startling success in a game against Connor Five that immediately followed the A League opener.

At one point, seemingly all of the Bombers' offensive players happened to be on their backs and sliding en masse toward the enemy goal. The enemy goalie, not noticing the puck in the debris, turned his back on the advancing horde, to see if it had already snuck into his net—a fatal mistake, for it hadn't. Someone, still on his feet, found it and tapped it in for a goal. From the sidelines and atop the Bombers' box, the fans beat out this savage tattoo:

"One, two, three, four!" Pause. "We want more!"

The two referees decided that when the infraction was blatant enough, they'd stop play. They did so, for example, when four of the Bombers were simultaneously offside. That annoyed a fan. Why, he asked, stop the show at all?

Referee John Kavazanjian, '72, patiently explained that the teams had doubtless seen hockey games on television and expected to hear a whistle and have a face-off every now and then.

The final score, according to the official scoresheet, so we shall have to trust it: Burton Third Bombers, 6; Connor Five, zero.

Competence and seriousness generally increase in the leagues from C to A, and as the season progresses.

For example, the rules permit a team to pull its goalie from the game in the last minute of a period and put in an additional offensive player while leaving its goal unprotected. In a game two weeks into the season, goalie Markowitz decided he'd do this, and streaked from the goal toward his team's box, hollering for an offensive player as he went.

The fans heard a loud noise, and looking toward the box, saw two feet sticking into the air and another player bolting from the box. The fans loved it.

At the sidelines, Rick Stadterman, '75, goalie for a Baker House C League team who'd stopped by to watch his dorm's A team perform, was also impressed. But he didn't think he'd ever make a similar dash for the box. His team "asked me to," he said, "but I told them I can't skate that fast."

Drugs at M.I.T.? "The Tech" 's Editor Files a Current Report

Lee D. Giguere, '73, Editor-in-Chief of The Tech, *has watched current events at M.I.T. as an undergraduate editor for nearly four years. Here is his midwinter report on the "M.I.T. drug scene":*

Despite changing patterns of drug use in recent years, marijuana, the infamous "weed," remains the chief topic in discussions of drug use at M.I.T.

Estimates of on-campus use vary widely. Captain James Olivieri of the Campus Patrol says that "pot seems to be on a reduced scale." Two dormitory residents polled by this reporter differed in their estimations: one reported that "the use of marijuana is small but there," adding that there "may be more people smoking than two years ago." Another stated that "smoking" is "something that doesn't start until the guy's a sophomore" and tied the amount of use to the time of the term. A member of one of M.I.T.'s 29 fraternities said he would be "willing to take bets that the direction is from more to less" in the system.

Outside of marijuana, the M.I.T. drug market appears small. Of "hard" drugs, Captain Olivieri claims, "We don't have a serious problem on campus." The acid scene, in particular, he says, has dropped from a 1969-70 peak; since then the number of "serious cases" has tapered off.

The chief market for "speed" is as an aid in studying; one student reported, "I know people who would like to get 'speed' to study on, but it's really hard to get." Another student commented: "I don't know of anyone in the house who 'speeds'—a couple of years ago there were." Nor did he know of anyone using hallucinogens.

Dr. Alfred J. Koumans, Psychiatrist in the M.I.T. Medical Department, pointed to a new trend in drug usage, however. Methaqualone, known as "qualude" or "sopor,"is reaching the black market, he said, after being pushed on doctors by drug manufacturers. A nonbarbiturate hypnotic and cortical depressant, "sopor" drug can produce a stupored, drunken state.

"Out into the Open"

The use of marijuana doesn't attract much attention any more. Last spring, about 150 people gathered in M.I.T.'s Great Court one afternoon for what was billed as the "J. Edgar Hoover Memorial Dope Party." In spite of the blatant illegality of the event—it was reported that many people "blithely distributed cannabis products through the crowd"—no arrests were made by the Cambridge Police narcotics division plainclothesmen reportedly present.

"It's come out into the open a lot," commented one senior in reference to grass. Four years ago, he said, "I only knew three or four people out of a group of seventy who were using grass, although there could have been more." Currently, about half the members of his 32-member living group smoke.

Education Instead of Repression

What does M.I.T.'s Campus Patrol see as the principal source of the campus "drug

problem"? "The most dangerous situations," says Captain Olivieri, "occur when persons from the outside community come into the dorms." Last year, in fact, several arrests were made by the Patrol in such situations.

With M.I.T. students, Captain Olivieri said, the Patrol's theory is to avoid "repressive measures" in favor of educational programs aimed at making people aware of things that might endanger others.

Questioned about "busts" on campus, Captain Olivieri commented, "I don't know of any pot parties of late that've been broken up." He quickly added, however, that neither M.I.T. nor the Patrol have any "special arrangements with Cambridge that affords students special protection." There is no guarantee that Cambridge narcotics officers will confer with the Patrol before they move on campus, Olivieri explained; the fact that there have been no students arrested on campus in a number of years on drug charges is simply due to the good working relationship that exists between city police and the Campus Patrol.

Three Computers, Two Departments

Speed and diversity characterize a new computer facility now in use in the Departments of Mechanical and Civil Engineering. In past years the two departments used two separate I.B.M. 1130 computers, and the decision to replace these and to centralize computer activities at a single location reflects the conclusion that the two departments' overlapping hardware requirements can be fulfilled by a single system despite each department's differing philosophies and requirements.

The new hardware configuration consists of three mini-computers joined together and organized as follows:

One Interdata Model 70 mini-computer functions strictly as an input/output handler, servicing the card reader, line printers, plotters, and communication lines to the Institute's Information Processing Center (I.P.C.). This computer employs a fixed head disk to store input/output files and transmits data to and from the satellite processors as required; it handles routine accounting procedures and has utility programs to plot general display files, including files transmitted from I.P.C. No user programs are run on this machine.

A second Interdata Model 70 compiles and executes FORTRAN programs and executes general applications programs such as ACCESS II and DYSYS. This computer is provided with a five-megabyte dual disk drive (one fixed disk and one removable disk) and a Hazeltine C.R.T. terminal for on-line input/output. This computer can batch or singly execute jobs but daytime runs are limited to five minutes or less; it includes 32K bytes of core, with 1-μsec. cycle time and floating point hardware. It is intended to provide fast (as little as five minutes) program completion and low cost for small programs which require little or no programmer intervention.

The third computer, an Interdata Model 80, is compatible with the second Model 70 but is reserved for long, interactive runs (five minutes to two hours). It includes a five-Megabyte disk, an Imlac interactive graphics console, an analog computer interface, and a plug-in connector for user-supplied hardware.—*Barbara Cochran*

Democratic Cop-Outs?

What did the "political novices" who dominated the 1972 Democratic National Convention do during the election campaign, and will they remain active in politics and the party now that the voting is over?

More than 70 students studying political science at M.I.T. used their holiday vacations and M.I.T.'s between-semesters Independent Activities Period to poll a significant sample of the delegates. A random sample of some 540 of the 3,000 delegates to last July's Democratic National Convention were asked about their participation in party activities, their views of the campaign, and their hopes for the party's future. During the spring term the students will analyze the results to develop some answers to those questions, and to the larger question of the future of the Democratic Party.

Norman Sandler, '75, points out that "delegates usually are interviewed repeatedly immediately before and during a political convention, but they are largely neglected during and after the election.

"To the best of our knowledge,"says Mr. Sandler, who is one of the coordinators of the student project, "the last time anyone attempted a post-convention delegate survey was 1948. It consisted of nine questions on a postcard."

Mr. Sandler also was a leader in an earlier M.I.T. student study conducted, in part, at the Miami Beach convention itself and aimed at understanding how the new rules and reforms that were meant to open the party to more and different kinds of people—the young, women, minorities, new activists—were adopted.

"Many people feel that reforms such as the ones adopted by the Democrats hold the only hope for the two-party political system of American politics," Mr. Sandler says. But he is not yet convinced that these reforms have actually done anything to open the party—except by changing the delegate selection to the national convention.

Development Foundation

The ranks of the Directors of the M.I.T. Development Foundation, Inc., have been increased by two: Clint W. Murchison, Jr., a member of the M.I.T. Corporation who is a partner in Murchison Brothers, Dallas, Texas; and Edward F. Neild, III, '60, Senior Vice President and Director of Blyth Eastman Dillon and Co., Chicago.

The Foundation is a private corporation controlled by M.I.T. It hopes to acquire an understanding of technology transfer through research, teaching, and actual participation in the formation of new enterprises. Its President is Richard S. Morse, '33, Senior Lecturer in the Sloan School of Management.

James C. Keck, Ford Professor of Engineering at M.I.T. (top), is working with the one-cylinder test engine in the Sloan Automotive Laboratory used to confirm model predictions of internal-combustion engine pollutants, while Michael K. Martin, '73, poses with the Wankel rotary engine which will be studied under a new National Science Foundation grant to the Department of Mechanical Engineering announced this winter. (Photos: Marc PoKempner)

Modelling Automotive Pollutants: 1976 Standards Cannot Be Met

Analysis of the hydrocarbon, carbon monoxide, and nitrogen oxide emissions from internal combustion engines has now been reduced to mathematical modelling. The theory and models show the effects of changes in engine configuration and combustion conditions on the production of all three pollutants, and this work has convinced one M.I.T. engineer that the automobile industry "will not be able to meet the 1976 air pollution standards by '76, even with catalytic attachments."

But John B. Heywood, Ph.D.'65, Associate Professor of Mechanical Engineering, is not entirely pessimistic. "The 1976 goals ultimately will be reached," he told the Associated Press this winter. "The lead time to 1976 is simply too short; the automobile industry probably will need two or three more years."

The computer modelling techniques developed by Professor Heywood, James C. Keck, Ford Professor of Engineering, and several colleagues and students make it possible to demonstrate without laboratory testing the effect on exhaust emissions of changes in such engine variables as the shape of the cylinder, spark timing, and compression ratio. Model results can be confirmed in a one-cylinder test engine in the Sloan Automotive Laboratory—which Professor Heywood directs—which allows precise control over operating conditions and exact measurement of all emissions.

One modelling effort related to nitrogen oxide formation has been used by Ford Motor Co. engineers to design a new variation of the spark-ignition internal-combustion engine—a "fast burning engine"—which consumes fuel in such a way as to markedly reduce nitric oxide emissions. But at least for the present the new design has by-products also predicted by the M.I.T. model: increased carbon monoxide and hydrocarbon emissions.

A new $44,600 grant from the National Science Foundation will support Professors Heywood and Keck while they try to extend their modelling techniques to Diesel, Wankel rotary, and stratified charge engines. This, thinks Professor Heywood, is a good example of how an educational institution can best contribute to solving major engineering problems. "We cannot compete with industry in developing hardware, but we do have more experience in using analytical techniques."

The Kenan Scholar-Teachers

Giving funds to M.I.T. early this year, Trustees of the William R. Kenan, Jr., Charitable Trust asked to help support scholar-teachers of distinction "whose enthusiasm for learning, commitment to teaching, and interest in students will make a notable contribution to the undergraduate community."

In the two recipients, M.I.T. has selected —in the opinion of both colleagues and students—"unusually dedicated and imaginative teachers," says Walter A. Rosenblith, Provost. He believes the program and its first appointees reflect "the Institute's desire to encourage . . . devotion to the welfare of undergraduates."

The two recipients are:

☐ Suzanne Berger, Associate Professor in Political Science, who is known as a student of French society and politics and is now working on the development of advanced industrial societies.

☐ Arthur Steinberg, Associate Professor of History and Archaeology, described by Richard M. Douglas, Head of the Department of Humanities, as "a major figure in securing the introduction of a combined program in anthropology and archaeology at M.I.T."

Eugene B. Skolnikoff, '49, Head of the Department of Political Science, credits Dr. Berger with "impressive contributions to the teaching and research programs of the Department, . . . a rare gift for arousing the interest and enthusiasm of her students."

Dr. Steinberg's understanding of metallurgy, classical history, and art history enable him to "teach with double literacy and competence, which contributed significantly to the formation of a fresh kind of archaeological scholarship," according to Professor Douglas.

The Kenan Award provides a special grant at the disposal of each recipient "for the advancement of his or her scholarly and educational activities."

Rooms for Rent . . .

. . . in Random Hall, a typical Cambridge brick four-decker three blocks west of M.I.T. on Massachusetts Avenue.

Acquired by M.I.T. in the 1960s, Random Hall was used as an "overflow" undergraduate residence until MacGregor and Burton Houses were completed; now its rooms are available by day, week, or month to anyone with an M.I.T. affiliation, including alumni, at $5 single, $7 double daily.

The Real Estate Office thinks the arrangement ideal for "visitors, parents, people who can't make lease commitments, people who want uncomplicated housing arrangements . . ."

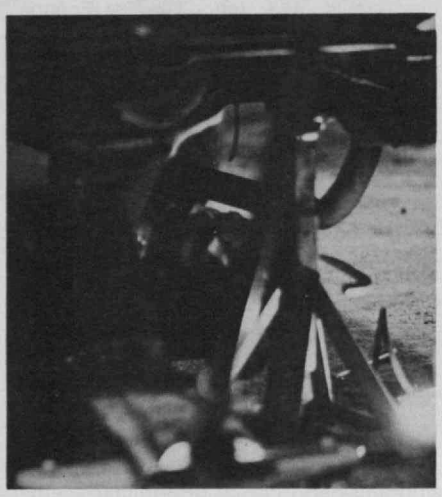
Mathis Lectureship

A memorial lectureship honoring the late Sam J. Mathis of Standard Oil Co. (New Jersey)—now Exxon Corp.—will be established with funds given to M.I.T. by Mr. Mathis' widow, Mrs. Kathryn Mathis of Pinehurst, N.C.

Income from the Mathis fund will be used to invite prominent civil engineers to lecture at the Institute.

Though not an alumnus of the Institute —he studied civil engineering at the Citadel, Charleston, S.C.—Mr. Mathis worked closely with several members of the M.I.T. Department of Civil Engineering, notably T. William Lambe, Sc.D.'48, Turner Professor of Civil Engineering, during overseas assignments for Standard Oil.

Before joining Standard Oil Co. (New Jersey) in 1946, Mr. Mathis had been associated with the U.S. Coast and Geodetic Survey, the South Carolina State Highway Department, and the U.S. Navy, and Raymond Concrete Pile Co.



The man behind the counter giving advice (right, above)—is John H. Schenck, '73, one of three entrepreneurs involved in Boston's first do-it-yourself auto repair shop. Baltex, Inc., can take 19 cars at once, keeps a stock of tools (including metric ones for foreign cars), and provides free soap and water for the customers when the job is done. (Photos: Sheldon Lowenthal, '74)

Self-Service Entrepreneurs: The Customers Are On Their Own

The tools you need—even soap and water when you're done—are included in the deal. For $2 an hour you get a bay at Baltex, Inc., a self-service auto repair shop near Kenmore Square, Boston, whose entrepreneurs are Mike Miller (a Harvard Business School student), John Price, Jr., and John Schenck; the last two are M.I.T. students, Price a graduate student and Schenck an occasional undergraduate who needs only a few courses to finish his S.B.

It all began last summer when the two M.I.T.-related proprietors met while working on an ocean engineering project near Castine, Me. (*see* Technology Review *for October/November, pp. 78-79*). Such do-it-yourself auto shops are not unknown; indeed, Baltex, Inc., may soon have competition from a national franchise group. For the present it's believed to be the only one of its kind in New England.

The location—in the center of Boston's apartment-dwelling student community—is by design. Especially in the winter, apartment-dwellers who want to do their own repairs on their cars need a warm, dry place in which to work. But Mr. Schenck thinks there's more to it than that: special as well as all regular tools are available, every bay has compressed air, and—for a small extra charge—you can use such special equipment as electronic analyzers, tire balancing and wheel alignment stands, and arc and gas welding gear.

Baltex also wants to sell you parts; it keeps a fair stock and knows where to get others, and it gives "a break" on those not fair-traded. There is a big file of service manuals. But its insurance coverage won't allow Baltex' proprietors to give advice or help; the customers are on their own.

With Mrs. Benedict in the background, Manson Benedict, Ph.D.'35 (left), receives congratulations from President Jerome B. Wiesner on November 6. Dr. Benedict—whose contributions include extensive government consultations on nuclear energy policy as well as his role in founding and heading the M.I.T. Department of Nuclear Engineering—had just been named for the 1972 Enrico Fermi Award of the A.E.C. (Photo: Marc PoKempner)

Honoring a Nuclear Builder

President Richard M. Nixon to Manson Benedict, Ph.D.'35, Institute Professor and former Head of the Department of Nuclear Engineering, on November 2, 1972:

"Your devoted service to the Atomic Energy Commission and your tireless efforts in educating nuclear engineers have properly won for you the highest esteem of your colleagues both here and abroad."

To these—and many other—plaudits, President Nixon then added the A.E.C.'s 1972 Enrico Fermi Award of $25,000, officially presented to Dr. Benedict four weeks later at the University of Chicago during ceremonies to mark the 30th anniversary of the first sustained controlled nuclear chain reaction.

"As a scientist, teacher, and engineer you have a significant influence in the field of atomic energy and its applications to society," President Nixon's letter continued. That influence was building even before Professor Benedict returned to M.I.T's Department of Chemical Engineering in 1951 to organize a program of research and teaching in nuclear engineering. He had already been the principal designer of the gaseous diffusion plant in Tennessee which produced the first uranium-235 for wartime use and later proved the feasibility of this material of power reactors. Seven years after he returned to the Institute, when his work and planning led to establishment of the Department of Nuclear Engineering, Dr. Benedict became its Head—a post from which he retired in 1971.

Mauze Professorship

The Abby Rockefeller Mauze Professorship, designed to bring distinguished women scholars to M.I.T., is this year held by Laura M. Roth of the General Electric Research and Development Center in Schenectady; commuting to M.I.T., Dr. Roth is conducting a seminar series on "Electron States in Disordered Systems" in the Department of Physics.

Dr. Roth's recent research has centered on solid state theory, electronic properties of semiconductors, magnetism, and disordered systems; she serves in the Semiconductor Physics Branch at G.E.'s laboratories.

Dr. Roth was a staff physicist at the Lincoln Laboratory from 1956 to 1963; during some of this time she was completing work for her Ph.D. in physics at Radcliffe (1957). Later, before going to General Electric, she served on the Tufts faculty as Associate Professor and Professor in the Department of Physics, and she has taught special activities at Harvard and at the University of Colorado's Institute for Theoretical Physics.

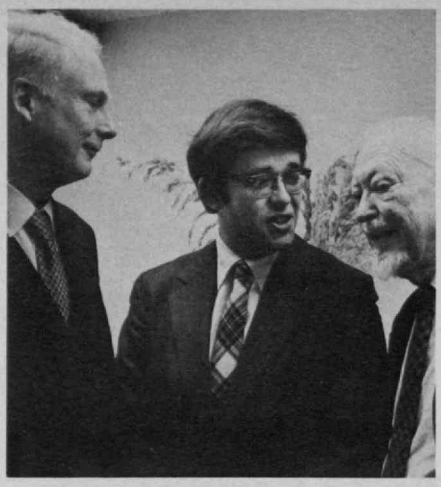
Dreyfus Teacher-Scholar

A $28,000 Teacher-Scholar Grant from the Camille and Henry Dreyfus Foundation will help Clark K. Colton, Assistant Professor of Chemical Engineering, expand his activities in applying chemical engineering to medical and biological problems.

Professor Colton is one of 17 teachers at U.S. universities designated by the Dreyfus Foundation for 1972 awards; the program is seen as a means of "promoting the careers of outstanding young teacher-scientists in chemistry, biochemistry, and chemical engineering."

A graduate of Cornell University, Professor Colton joined the M.I.T. faculty in 1969 upon receiving the Ph.D. degree here; he is a member of the Clinical Research Center Policy Committee and the Committee on Biomedical Engineering and has published extensively on the design and performance of artificial internal organs. His present research is on enzyme technology.

Four members of the M.I.T. community drew down top awards at the 1973 annual meeting of the American Institute of Aeronautics and Astronautics: David G. Hoag (left), '46, Director of N.A.S.A. Programs at Draper Laboratory, and Richard H. Battin, '45, Draper's Apollo Mission Director, the Louis W. Hill Transportation Award; Sheila E. Widnall, '60, Associate Professor of Aeronautics Astronautics, the first woman to receive the Lawrence Sperry Award; and Edward S. Taylor (right), '24, Professor of Flight Transportation, Emeritus, the Robert H. Goddard Award.



Musicologists can—if they but will—be a liberating force for music, says Robert S. Freeman, Associate Professor of Music at M.I.T., who succeeds Howard Hanson (right) as Director of the University of Rochester's Eastman School of Music. "The scholar's research for historical authenticity must not blind us . . ." he told the Eastman's School's faculty at a convocation late last year.

On the Role of Theory in Practice—in Music

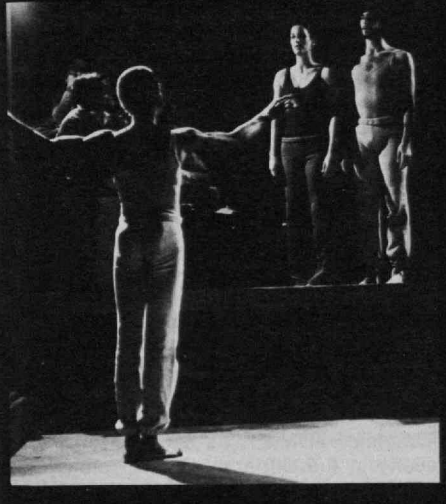
If there is a gulf between scientist and engineer, so is there one between musicologist and musician.

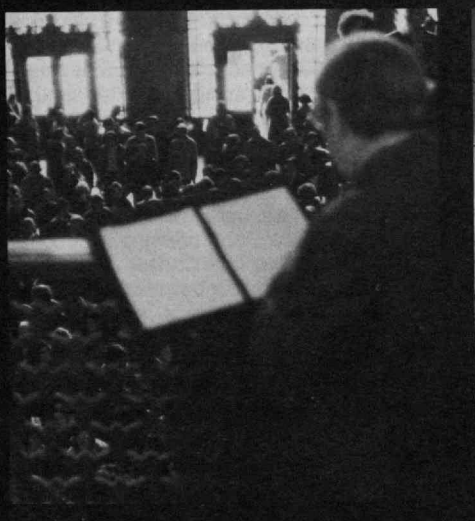
Let it be closed, says Robert S. Freeman, Associate Professor of Music at M.I.T. who this year becomes Director of the Eastman School of Music at the University of Rochester. "It is my dream," he told the music school's faculty at a convocation early in the winter, "that specialists may learn to work together, and that in doing so, we will all become better musicians for it . . .

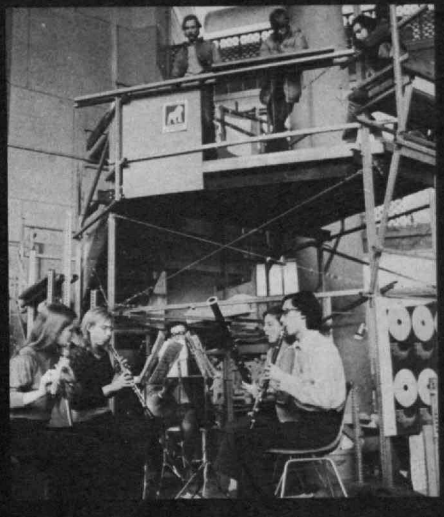
"It is among the tasks of the music historian to clarify the composer's intention. But we historians have done our task so well that a great many performing musicians now believe we know more than we really do. . . The scholar's research for historical authenticity must not blind us to the fact that, in any style, there is a broader latitude of dynamic, articulative, and agogic possibilities than earlier musical notations can possibly indicate. The historian can, in a given situation, exclude a range of performance possibilities which would be clearly inappropriate. But, for any given work, there exists a much broader spectrum of stirring (and no less historically authentic) possibilities than many a performer presently conceives of.

"It is the work of the speculative theorist to chart these largely unexplored regions for us. The analysis of a musical work often seems of questionable relevance to performers. It need not. Questions of orchestral balance, of variability of tempo, and of hierarchies of climax, for example, are vital to the best performances. There are some fine musicians who intuit well about such matters; but there are other colleagues whose music-making, I think, could be liberated through such considerations as these."

The Gallery







Almost since it was built in 1938, the foyer of the Rogers Building, M.I.T.'s main entrance from Massachusetts Avenue, has attracted the imagination of architects: with space at a growing premium, what to do with the austere, 90-ft. cathedral in the style of another era? This year's answer: make it into a community center, with continuous conversation and the occasional entertainment sampled in these pictures (clockwise, starting above): Gus Solomons, Jr., '61, and his Dance Company; pottery from the Student Art Association; Maggie Lettvin and her exercise class; President Jerome B. Wiesner at the Christmas Convocation; woodwind quintet noon-hour concert; a jazz jam session with Professors Roy Lamson, Warren Rohsenow and Arthur Litchfield (the program included "The Building 7 Boogie"); and "the double piddle hydraulic happening machine" from Professor Harold E. Edgerton's (Sc.D.'31) Stroboscopy Laboratory. (Photos: Margo Foote, Marc PoKempner, and Sheldon Lowenthal, '74)

A Continuing Golf Saga . . .

. . . will give M.I.T. by the end of the spring some regional and one national alumni golf champions. Local tournaments are now being organized—so far in Los Angeles, Wilmington, Del., Chicago, and Boston—by alumni clubs. By the end of the spring, equipped with the names and handicaps of local winners and the names and U.S.G.A. ratings of the courses on which they played, G. Peter Grant, '35, Director for Clubs, will pick a winner.

All alumni are invited to play—by signing up with their local clubs' golf enthusiasts or by organizing the tourney in their areas.

Great History, Great Class

That's the title—"A Great History of the Great Class of 1923"—of their collective autobiography.

It was commissioned by the officers of the Class of 1923 three years ago, and the result of a staff of 40 volunteer associate, research, photographic, and biographic editors will be unveiled for several hundred members of the Class (originally 1,100 graduates) when they gather for a 50th reunion in Boston in June.

There will be a narrative record of life at M.I.T. and biographies which document "the thoughts and actions and successes as human beings to leave the world a little better place in which to live" of members of the Class, says Arthur W. Davenport, '23, Managing Editor.

Mr. Davenport is certain that many alumni, interested in M.I.T. and "the 1,100 men and women who were destined to be the pioneers in the Institute and to make men and events immortal," will want copies. The prepublication price is $27.50, and checks should be sent to Mr. Davenport at Box 574, Virginia Beach, Va., 23451.

Ednah Blanchard, 1893-1972

Ednah Blanchard, Administrative Secretary in the Department of Electrical Engineering for 40 years before her retirement in 1959, died on December 6. She was 79.

Miss Blanchard came to the Institute in 1919. She served the Department of Electrical Engineering under four heads; her knowledge of the Department was second only to that of the late Carlton E. Tucker ('18), who was the Department's Executive Officer during much of the same period. She was widely known among at least 10 generations of students in the Institute's largest department, and her standards for administration of the Department set a target for many others.

Victor O. Homerberg, 1889-1972

Victor O. Homerberg, Professor Emeritus of Physical Metallurgy at M.I.T., died on December 9 at his home in Santa Barbara, Calif. He was 83.

An authority on alloys of iron and steel, Dr. Homerberg started his career at M.I.T. as a student, receiving his S.B. in 1921 and his Sc.D. in 1927. Following his graduation, Dr. Homerberg became an instructor in physical metallurgy and was promoted to assistant professor in 1925, associate professor in 1928, and professor in 1939.

Dr. Homerberg retired from the Institute in 1950. He and his wife, Jessie Delisse Golden, moved to Santa Barbara where Dr. Homerberg pursued his hobby of gardening and continued his professional work on a consulting basis.

Alfred T. Glassett, 1900-1972

Alfred T. Glassett, '20, former President of W. J. Barney Corp., died at his home in Pompano Beach, Fla., on December 3; he had been President of the M.I.T. Alumni Association in 1951-52 and was 72 years old.

Mr. Glassett studied civil engineering at M.I.T. and joined the company which he later headed four years after graduation. He retired in January, 1972, after having become widely respected throughout the construction industry during nearly 50 years of association with that firm. Mr. Glassett served not only as President but as Treasurer and Director of the firm.

He was a life member of the American Society of Civil Engineers and a Director of its Metropolitan Section, and he had served the Construction Division of the National Safety Council, the New York Engineers' Committee on Student Guidance, the National Society of Professional Engineers, and the National Fire Protection Association.

In addition to his service as Alumni Association President, Mr. Glassett was a member of the M.I.T. Corporation from 1951 to 1957; an Honorary Secretary of the Institute, he was President of the M.I.T. Club of New York from 1935 to 1940, and had been a member of the Alumni Fund Board and of a number of Corporation Visiting Committees.

The family suggests that memorial gifts be made to the M.I.T. Alumni Fund, designated for the Civil Engineering Graduate Fellowship Program.

Hugo Muench, 1895-1972

Dr. Hugo Muench, Visiting Professor of Biostatistics in the Department of Nutrition and Food Science from 1967 to 1969, died at his home in Cambridge on November 16.

Dr. Muench was Professor Emeritus, of Biostatistics, of the Harvard School of Public Health and a consultant at the Lemuel Shattuck Hospital. He was an assistant dean at the Harvard School of Public Health from 1946 to 1954.

Dr. Nevin Scrimshaw, head of the Department of Nutrition and Food Science, said, "It was a privilege for those who took Dr. Muench's course here to have him share his knowledge in a complicated field, which he did with clarity and a gentle, dry sense of humor."

Roland D. Parks, 1900-1972

Roland D. Parks, who taught mineral economics at M.I.T. as a member of the faculty in the Department of Geology for 24 years beginning in 1940, died suddenly on Monday, December 18, at his home in Arlington, Va. He was 72.

Robert R. Shock, Head of the Department of Geology (now Earth and Planetary Sciences) during much of Professor Parks' tenure, credits him with bringing to the Department a broad background in "the fundamentals of minerals and ore deposits, world mineral resources, the economic importance of minerals, and especially the importance of these commodities in international affairs."

Professor Parks was on leave from M.I.T. for two years before his official retirement in 1966, having accepted a position with the Mineral Resources Department of the Internal Revenue Service. He continued this work until 1970, meanwhile also serving as an associate member of the consulting firm of Behre Dolbear and Co., New York, and since 1970 he had continued travelling and consulting assignments for the U.S. Treasury.

Professor Parks had also been on leave from M.I.T. during World War II, to serve with the War Production Board; in 1955-

56, to be Guest Professor at the Indian School of Mines and Applied Geology, Dhanbad, India; and in 1961-62, to be Fulbright Lecturer in Mining Engineering at Assiut University, Egypt. Before coming to M.I.T. in 1940 he had been for nearly 20 years a member of the faculty at the Michigan College of Mining and Technology (now Michigan Technological University) from which he held B.S. and E.M. degrees (1921). Professor Parks had studied at the University of Wisconsin for the M.S. (1925).

Professor Parks was born in Lake Linden, Mich., and his first geologic work was with the mines, miners, and hidden wealth in the famous copper-bearing deposits of Northern Michigan.

Individuals Noteworthy

Awards and Honors: **Charles W. Mueller**, Sc.D.'42, received the J. J. Ebers Award by the Electron Devices Group of I.E.E.E. . . . From the American Meteorological Society: to **Glenn R. Hilst**, '48, the Charles Franklin Brooks Award; **Robert E. Dickinson**, Ph.D.'66, and **James R. Holton**, Ph.D.'64, share the 1973 Meisinger Award . . . **Evan A. Edwards**, '37, named Engineer of the Year by the Rochester Engineering Society . . . to **Cheryl Martin**, '72, third place in the 1972 Engineering Design Competition sponsored by the James F. Lincoln Arc Welding Foundation . . . to **Oscar T. Marzke**, Sc.D.'32, the first Highway Research Board Service Award . . . to **Roger W. Johnson**, S.M.'58, the Air Force Distinguished Flying Cross . . . to **Charles E. Huckaba**, S.M.'47, the Stephen L. Tyler Award for 1972 by the American Institute of Chemical Engineers . . . to **Robert C. Seamans, Jr.**, Sc.D.'51, the Department of Defense Distinguished Public Service Medal . . . **Daniel Brand**, '58, awarded the Pyke Johnson Award by the Highway Research Board . . . to **James H. Schulman**, '39, the Navy Award for Distinguished Achievement in Science . . . to **Charles Stark Draper**, '26, the Lamme Medal for 1973 from the Institute of Electrical and Electronics Engineers. . . . **Walter H. Stockmayer**, '35, awarded an Honorary Doctorate from Louis Pasteur University, Strasbourg, France.

Professional and Corporate Changes: **A. Rufus Applegarth, Jr.**, '35, to President of Aradar Corp. . . . **George H. Vineyard**, '41, to Director of Brookhaven National Laboratory . . . **Gerald D. Laubach**, Ph.D.'50, to President of Pfizer, Inc. . . . **James P. Gould**, S.M.'46, to the partnership of Mueser, Rutledge, Wentworth, and Johnston . . . **Steven I. Freedman**, '56, to Vice President of International Utilities Energy Systems, Inc. . . . **Joseph L. Kaufman**, '44, to the Governing Board of the American Stock Exchange. . . . **James B. Fisk**, '31, to Chairman of the Board of Bell Laboratories, and **Kenneth G. McKay**, Sc.D.'41, elected Executive Vice President . . . **Charles W. Ellis**, '51, to Vice President and Assistant General Manager of Boeing Vertol Co. . . . **Edward H. Carman**, S.M.'59, to District Sales Manager for Eastman Kodak Co. . . . **Benjamin C. Allen**, Sc.D.'54, to the staff of the American Chemical Society's Chemical Abstracts Service . . . **Irwin Dorros**, '56, to Executive Director of Bell Laboratories . . . **T. Marshall Hahn, Jr.**, Ph.D.'50 named a member of the Board of Directors of Georgia-Pacific . . . **Robert M. Sterrett**, '57, to Assistant Director, Product Development Division, Eastman Kodak Co. . . . **Robert R. Sparacino**, Sc.D.'61, to Vice President, Research and Engineering Division, Xerox Corp. . . . **William R. Zimmerman**, '48, to the Board of Directors of Trust Company of the West . . . **William M. Ryan**, S.M.'64, to Vice President of Administration for Standard Havens, Inc. . . . **John R. Hutchins, 3rd**, Sc.D.'59, to Director of Research and Development, Corning Glass Works . . . Evans Products Co. has named **Sheldon Kaplan**, '48, Chief Executive Officer . . . **Norman L. Laschever**, '40, appointed Planning Manager for R.C.A. Aerospace Systems Division, R.C.A. . . . **Michael Gross**, '60, to Assistant Vice President, Systems Engineering, Bunker Ramo Corp. . . . **J. William Graham**, S.M.'52, to Vice President of Signatron, Inc. . . . **John D. Bender**, '47, to Manager of Marketing, Ordnance Equipment Programs, General Electric Ordnance Systems . . . **Thomas H. Farquhar**, '60, to Vice President, Operations Research, Massachusetts Financial Services . . . **James N. Marshall**, '68, to Production Manager of Colonial Abrasives Co. . . . **John W. Gaylord**, '52, to Manager, Power Technology, R.C.A. Solid State Technology Center . . . **Bruce G. Curry**, '52, to Vice President, Management Systems and Services, Hertz Corp. . . . **David F. Petherbridge**, S.M.'67, named Assistant Superintendent, Construction Division, Eastman Kodak Co. . . . **J. Garnett Nelson**, '61, appointed Second Vice President of Richmond Corp. . . . **Wendel W. Cook**, S.M.'68, to Assistant General Manager, Kodak Park Division . . . **Anthony Frothingham**, '44, to General Manager of motion picture markets division, Marketing Division; Eastman Kodak Co.

Academic Appointments: **Willis G. Lawrence**, Sc.D.'42, appointed Dean of the New York State College of Ceramics at Alfred University . . . **Bernard Saul Levy**, '59, to Assistant Clinical Professor of Psychiatry, Harvard Faculty of Medicine . . . **Woodie C. Flowers**, S.M.'71, to Assistant Professor of Mechanical Engineering at M.I.T. . . . **Arnold R. Weber**, Ph.D. '58, to Dean of the Graduate School of Industrial Administration, Carnegie-Mellon University . . . **E. Russell Johnston, Jr.**, Sc.D.'49, appointed Head of the Department of Civil Engineering, University of Connecticut . . . **Thomas F. Malone**, Sc.D.'46, to direct Butler University's Holcomb Research Institute.

Professional Societies: **Alex Burr**, '32, awarded a Certificate of Life Membership in the National Society of Professional Engineers . . . **Thomas J. Kelley**, S.M.'70, and Daniel J. Fink, '48, elected Fellows of the American Institute of Aeronautics and Astronautics . . . **Gerry Lessels**, '50, elected a National Director of the American Institute of Chemical Engineers . . . **Janet Guernsey**, Ph.D.'55, to Vice President, American Association of Physics Teachers . . . **William H. Klein**, S.M.'44, and **Jerome Namias**, S.M.'41, elected Councillors of the American Meteorological Society.

Deceased

William C. Lounsbury, '03, December 12, 1972
George K. Kaiser, '04, October, 1972
William G. Abbott, Jr., '06, November 22, 1972
Edward C. Story, '07, July 12, 1972
George E. Hodson, '09, December 21, 1972
Ralph E. Irwin, '09, January, 1970
Lockwood J. Towne, '09, December 22, 1972
Clifford L. Hufsmith, '11, January 29, 1972*
Lester W. Perrin, '11, January 6, 1973*
Ralph T. Walker, '11, January 17, 1973
Lawrence B. Walker, '12, December 23, 1972
Marquis S. Smith, '14, August 8, 1971*
Ralph V. Davies, '16, December 26, 1972
Howard P. Claussen, '16, January 13, 1973
Samuel Lapham, '16, October 2, 1972
G. Radcliffe Stevens, '17, December 22, 1972*
Gretchen A. Palmer, '18, May 22, 1972
Francis T. Coleman, '19, November 20, 1972
Richard H. Coombs, '19, December 11, 1972
Adolf L. Muller, '19, November 21, 1972
Edward W. Noyes, '21, November 21, 1972
Richard S. Chatfield, '22, December 7, 1972*
Hyman L. Rosengard, '22, January 17, 1973
William F. Barrett, '23, December 6, 1972*
Lewis L. Harr, '23, May 11, 1972
John J. Grabfield, '24, December 9, 1972
Holland H. Houston, '24, September 24, 1972
Spencer W. Prentiss, '25, December 20, 1972
Mrs. Dorothy R. Gilligan, '26, December 14, 1972
John K. Donald, '27, November 2, 1972
Joseph A. Jamison, '28, July 22, 1972*
Eugene H. Gilman, '29, December 19, 1972
Clifton B. Smith, '29, October 14, 1972
Fabian R. Tandler, '29, June 15, 1972
Vinton L. Yeaton, '29, December 13, 1972*
Arthur G. Anderson, '30, February 23, 1972
Warren H. Dolben, '30, December 18, 1972
Stephan C. Gawlowicz, '31, June, 1972
Winthrop D. Hodges, '31, December 13, 1972
Richard L. Huntington, '31, August 9, 1972
J. Adron Tropell, '34, January 17, 1973
William K. Houghton, Jr., '36, November 13, 1972
William S. Whiteside, '36, March, 1972
Joseph B. Kripke, '40, July 4, 1972*
Julius P. Molnar, '40, January 11, 1973
James F. Ellis, Jr., '43, December 21, 1972
George H. Fischer, '47, November 17, 1972
William A. Paar, '58, December 12, 1972
Charles E. Jackson, '64, March 9, 1969
Michel J. Chevalier, '70, December, 1972
*Further information in *Class Review*

June 3, 1973, 3 p.m....

...the start of two days of exciting events for M.I.T. alumni – Alumni Days '73: the Pops, panels, parties, plus much more...

Eye-Opening Exhibits
Come to Cambridge Sunday afternoon and see new displays throughout the M.I.T. campus, on exhibit both Sunday and Monday. The Hayden Gallery will have an important exhibition of 19th Century Italian Painting. Also, a commemorative exhibit "100 Years of New Women – M.I.T. Alumnae: A century of creative contributions in technology, the sciences and the arts" will be shown in the Hayden Library and in the main corridor. Exhibits from M.I.T. in Retrospect 1900-1925 will be in the lobby of Kresge Auditorium.

International Buffet – Sunday, 5:30 to 7
Enjoy a leisurely repast with your fellow alumni in the Sala de Puerto Rico at the Student Center, with informality the keynote. Continental and oriental cuisine for a scrumptious Sunday supper. An unlimited supply of draft beer is included, and wine will be available. **After supper, a fleet of buses to take you to:**

Tech Night at the Pops – Sunday, 8:30
Arthur Fiedler conducting at Symphony Hall. An unforgettable experience awaits. Members of the Boston Pops Orchestra, led by the Maestro himself, will play some of their famous hits, from the old classics to today's exciting sounds. A special performance, just for the members of the M.I.T. family and their guests, with several surprises planned. A sell-out is expected.

1984 and Beyond . . . Seeking a New Role for Technology
Panels from 9:30 a.m. to 10:30 a.m. and 2:30 p.m. to 4:45 p.m., Monday, June 4.
A survey of new developments in Science, Research and Education – and what they hold for mankind in the next 25 years. The speakers will include:

Margaret L.A. MacVicar '65, Assistant Professor of Physics, M.I.T. and Director of the Undergraduate Research Opportunities Program.

J. Herbert Hollomon '40, Director of the Center for Policy Alternatives, M.I.T.

Salvador E. Luria, Sedgwick Professor of Biology, M.I.T. Director of the new Center for Cancer Research and 1969 Nobel Laureate in Physiology or Medicine.

Memorial Service – Monday, 11:00 a.m. to 11:30 a.m.
A distinguished M.I.T. alumnus leads a tribute to those no longer here – a solemn moment in the M.I.T. Chapel.

Alumni Day Luncheon – 12 noon to 2 p.m., Monday
The traditional Alumni Day event in Rockwell Cage, with several non-traditional events added. Report to the alumni by Jerome B. Wiesner, President of M.I.T.

Gala Soiree – 5 to 6:30 p.m., Monday
A refreshing end to two days of festivities. Need we say more?

Plan now to attend. Watch for reservation forms or call or write the M.I.T. Alumni Association, Room E19-437, Cambridge, Mass. 02139. Act promptly – a sell-out is assured.

Class Review

96

Your Secretary stopped at the Fuller Memorial—Brockton Art Gallery while in the vicinity of Brockton and found a copy of its annual report, which indicates a steady growth in all activities. This unique community project was made possible through the generosity of **Myron Fuller**. During its four years of existence, art courses have been augmented by others in photography, ceramics and dance. One of the local colleges uses the facilities for all of its "laboratory" type work in fine arts. Many artists from surrounding communities, including Boston, have had work hung in the monthly exhibits. Each year more youngsters from Brockton are taking advantage of its varied programs.—**Clare Driscoll**, Acting Secretary, 2032 Belmont Rd. N.W., Washington, D.C. 20009

99

News has arrived that **Charles F. Whiting** died October 23, 1972, at a nursing home in Peterborough, N.H. His home had been at Cambridge, Mass., where he was to be commended for active participation in worthy causes.

He was a member of the Whiting Milk Company family having been its treasurer for many years. Concerned about the purification of milk, he entered our class taking courses in chemistry and bacteriology for a better understanding of his business. Previously, he was a graduate of Harvard in the class of 1897.—**Norman E. Seavey**, Acting Secretary, Apt. 514 Lucerne Towers, Orlando, Fla. 32801

05

I have sad news to report. **Harry P. Charlesworth** died at his home in North Caldwell, N.J., on December 30. It was a great shock to me, because I had had a card at Christmas telling me that he was about the same as when Ruth and I had seen him at his home in the Spring of 1971—namely, ambulatory and feeling pretty well, considering. It seems that shortly after writing that card he fell and broke his hip quite badly. He had the "pin" operation, but his system was unable to stand the shock. The funeral was held in Haverhill, Mass., his birthplace. Ruth and I wanted to go down, but weather conditions, snow and ice, prevented. A floral tribute was sent in the name of the Class. Harry was such a dear, kind, lovable fellow that it came as a severe shock to us. Most of you know the story of his life, but I am quoting from the issue of January 2, 1973, of the *Boston Herald:* "Haverhill—Services for Harry P. Charlesworth, 91, of North Caldwell, N.J., were held in Grace Methodist Church. Charlesworth, a native of Haverhill, and a graduate of Exeter Academy and M.I.T., was a former Vice President of the Bell Telephone Laboratories in New Jersey and former Assistant Chief Engineer of the American Telephone Co. He was a past President of the American Institute of Electrical Engineers and a past member of the M.I.T. Corp. In World War I, he served with the Army Communications Corps. He is survived by three sons, Roger, of Oklahoma City, Robert E., of North Caldwell, N.J., and Richard of Weston, and a daughter, Mrs. James Timpson of North Caldwell, N.J."

Christmas cards brought several bits of news. One from one of the daughters of **Herb Bailey** tells of his situation. Herb always gets out a family Christmas letter, and I quote excerpts from this one. "It's time again for our annual letter and since my father, Mr. Bailey, at 92 is not quite up to writing his own this year, we thought we would combine our news. Owen and I have decided that having grandchildren is one of the most rewarding experiences in life. True, she wears us out, but we love it and always ask for more." . . . **Sam Seaver** says he has been blessed with very good health and that he and his wife were surrounded by "the whole family," 30 in all including 15 grandchildren. Without a computer, it seems there must be several great grandchildren.

Herman Eisele says, "I have a solicitous housekeeper, one day per week, who takes care of those household chores for which I never had any talents or yearning. Although my cataract operation prevents me from driving, I still go by bus to my office in the Engineers Building, five days a week where I do a little professional work and take care of numerous personal matters and expurgate 65 years' accumulation of records. At 90 plus I have many limitations, but my health is still fairly good due to the careful supervision of eight medical specialists, who do the best they can with what they have to work with." Congratulations, Herman, and thanks for continuing to be one of our better correspondents. . . . Kathryne and **Harry Kendall** must be in good navigable condition, for they are in Hawaii for several months. . . . The **Leonard Cronkhites** know what it is to celebrate a ninetieth birthday (his) surrounded by children and grandchildren. Here's what he says. "The grandchildren put on quite a wonderful party. Each one did something—poems, a painting on glass, one frosted the birthday cake, one did a charming little ballet in her leotards, and later they played a Chopin record so that their grandmother and I could waltz while they took movies! All in all, a beautiful party to remember. Our doctor thinks Arizona is rather far away so we plan to go instead to Bermuda this year. Our address will be Willowbank, Somerset Bridge."

I am indebted to Ernest W. Graham, son of our **Errett Graham** of Shaw Island, Washington, for a bit of news about his father. "Up until about 18 months ago my father, Errett M. Graham, was quite active. He lived by himself, and worked outdoors six hours a day. Occasionally he paddled his canoe over to Friday Harbor or around Shaw Island. Of course

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Editor's Note: Two errors have been called to our attention in the reporting of the death on May 17 of **George B. Bradshaw**, '03 (Technology Review *for October/November, p. 90*). Credit for the authorship of *When M.I.T. Was Boston Tech* was incorrectly given to Samuel C. Prescott, '33; the author was, of course, his father—the late Sanuel C. Prescott, '94. We were also victims of a typographical error in referring to Mr. Bradshaw's "loyalty to his many employers." The correct reference should have been to "employees"; in setting the record straight Mr. Bradshaw's sister, Isabel Bradshaw, has called attention to the fact that George Bradshaw, "beginning three years after his graduation, had his own plants, manufacturing—under his own patents—rubber goods, dyes, the picric acid of the first World War, detergents, and so on . . ."—*J.M.*

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he was only 94 then. For the past year he has been in the Convalescent Center at Friday Harbor. He has had a heart problem and some artery troubles which have slowed him up. He walks around by himself, eats well, and seems comfortable. But he leaves business affairs and letter writing to me, his son. Sorry he couldn't reply to you personally. He remembers you and would send his best regards." Errett is our oldest member. He will be 96 on June 8, 1973. Address above; Zip Code is 98286.

This quotation from **Dean Klahr**'s Christmas card tells just a bit about their situation. "The enclosed picture was taken last September 9 just after my granddaughter's wedding in our back yard. Since that time both Helen and I have deteriorated. I passed my ninety-second birthday in October. I have sold my car and no longer drive, so that my traveling days are over, and I cannot again have the pleasure of stopping in to see you at your home." . . . Louise and **Frank Geraghty** sent a copy of their Christmas poem—original, I am sure—which Ruth and I appreciate each year. They add, "We are both well. The secret about living a long life is to keep active." I can echo that. . . . Hazel (Mrs. **A. Warren**) **Wells** says that Warren has his several aging problems, but is interested in life. His birthday is June 3 and his new address is 13A Azalea Dr., Aldersgate Retirement Center, Orange City, Fla. 32763.

I acknowledge with thanks Christmas greetings from Peg and **Bill Ball**, Anna and **Pat Sullivan**, **Bill Spalding**, Elizabeth and **Gilbert Tower**, **Charlie Mayer**, **Henry Buff**, **Hall Robbins**, **Roy Allen**, and **Lloyd Buell**. From the fact that they do not say anything to the contrary, I assume that they are doing pretty well—considering.

I have been in frequent contact with the **Charlie Smarts** by letter and phone. Charlie grows younger by the years, and Isabel is the social spark plug of the unique colony of East Acres, Troy, N.H. Charlie is constantly busy in his research on Ancient Surveying Instruments and keeping his (Gurney) Museum in order. Izzy, besides homemaking and socializing, finds time to help the good cause at Sage Foundation and other civic things. . . . I might add that 1972 was a wonderful year for the Goldthwaits—a Golden Anniversary (with all 22 of the kin present from all along the Atlantic Seaboard to North Carolina), then my ninetieth (with most of the 22 present), plus real good health.—**Fred W. Goldthwait**, Secretary, Box 231, Center Sandwich, N.H. 03227; **William G. Ball**, Assistant Secretary, 6311 Fordham Place, Bayshore Gardens, Bradenton, Fla. 33505

06

It is certainly proper for a remarkable man's long career to be specially and publicly acknowledged and honored as was that of **Roland P. Davis**, Dean Emeritus of the College of Engineering of West Virginia University, of Morgantown. Roland was born August 2, 1884 in Beverly, Mass., and went through high school there before joining our Class and obtaining his degree in Course I, Civil Engineering. He then went to Cornell, and by 1911 was Associate Professor of Civil Engineering at West Virginia University, also serving as Professor of Structural Engineering. He became West Virginia's first official bridge engineer in 1914 and was instrumental in organizing the State Road Commission—now Department of Highways. Last November Dr. Davis was honored by being installed as the 37th National Honor member of Chi Epsilon, the civil engineering honor fraternity. He was a founder of the West Virginia Society of Professional Engineers; was consultant for design and construction of Thatcher Ferry Bridge over Panama Canal, which was completed in 1962; an honorary member of the American Society of Engineers; its Director for two years and its Vice President in 1940. He was co-author of two major textbooks—*Foundations of Bridges and Buildings* and *Timber Design and Construction.* Dr. Davis certainly deserved the high honors bestowed upon him and we add the congratulations of his Class of 1906 of M.I.T.

In the notes in the February *Review* we reported the death of **William G. Abbott Jr.**, but gave no details of his career. Since then a clipping has been received from the Alumni Office containing those missing details. Bill was employed by the General Electric Co., in research and development. He developed the mercury arc lamp and the tungsten carbide filament; was a violinist with the Schenectady Symphony Orchestra; was commissioned a major in the first World War; was a member of the Army Ordnance Society; was head of Chemical Warfare Service in Washington; member of American Chemical Society of New York; Society of Chemical Engineers and American Association for Advancement of Science, of which he was made a life member in 1965. So those details that were missing add up to an outstanding career in scientific fields.—**E. B. Rowe**, Secretary-Treasurer, 11 Cushing Rd., Wellesley Hills, Mass. 02181

08

In reply to Ken Brock's appeal for Alumni Funds, we have received contributions from **Karl Kennison** who is putting two daughters through college, and from **Paul L. Powell**, who writes, "Am in good health for a man of 85. Have retired and am living in Baltimore with my family, a wonderful wife, a son and daughter, also three grandsons and one grand-daughter. Another note from **H. W. Blackburn** of Syracuse. He is well and expects to attend our 65th.—**Joseph W. Wattles**, Secretary and Treasurer, 26 Bullard Rd., Weston, Mass. 02093

11

Last October at its Fall meeting, the Massachusetts Charitable Mechanic Association awarded me an engraved "Paul Revere Bowl" for having been a member for 50 years. The bowl is a replica of the sterling silver "Liberty" bowl made by Paul Revere who was the founder and first president of the association. Replicas of the bowl are given by the mayor of Boston to important visitors to the city.

Harold Robinson reported the death of his wife, Frances, on October 30. They had been married 60 years and enjoyed them all. She had been suffering from leukemia for a long time. . . . I just heard of the death on January 29, 1972 of **Clifford L. Hufsmith** of Palestine, Texas. He was with us in Electrical Engineering but had never been active in class affairs.

Lester W. Perrin of Far Hills, N.J. died January 6 of this year at the age of 86. He was a former mayor of Bernardsville, N.J., graduated from Yale in 1908 and received his degree in Mechanical Engineering with us. In World War I he served in France as an infantry captain and later was attached to the Peace Conference at Versailles. After the war he was employed by the Guaranty Trust Co., and in 1925 joined Lazard Freres, Inc., Investment Bankers, retiring in 1935 as a partner in the firm.

Willis Hodgman of Taunton sent along this message with his contribution to the Alumni Fund: "Early this year (1972), the present ownership of this formerly family-owned business moved me over from President to Chairman and put me on a consultant basis. This action pleased me greatly. It is a fine way for me to finish out my business career. My general health is quite good and I may be around for quite a while yet."—**Oberlin S. Clark**, Secretary, 50 Leonard Rd., North Weymouth, Mass. 02191

12

Here we are in Swarthmore, the first winter I have spent in cold country since 1966. So far, in mid-January, we have had no snow, though it has been cold enough to get some. I received Christmas cards from 11 men which were much appreciated. Thank you all.

From Dr. **Dolphe Martin**, we have a letter sending New Year's greetings for all the Class. Dolph continues his work in the musical and medical fields, and took another trip to London, and Bermuda, in December. There are still 11 other classmates who are fully or partly employed—a remarkable record. . . . Ruth and **John Barry**, of Cohasset, Mass., are now both well, although John underwent a successful operation for a detached retina last summer and also had a bout with pneumonia.

Jesse Hakes took a 1972 cruise on the M.S. *Sagafjord* with Mary. They stopped first in Florida en route to the Panama Canal, and across the Pacific to Tahiti and other islands. Then to New Zealand and Australia, Bali, Singapore, and Hong Kong, continuing north to Kobe and Yokohama. On the final leg of the voyage, they crossed the Pacific to our west coast, south to visit Acapulco, and east again through the Panama Canal. They enjoyed the cruise so much that they planned another this year and left in January on the *Gripsholm* for a three-month's trip to Africa, India, Ceylon, Tai-

wan, Japan, and Hawaii. As previously reported, the Hakes met Dorothy (**Randall**) **Cremer** on the last cruise and she has accompanied them on this year's cruise.

Larry Cummings and Julie spent the summer at Squam Lake, N.H., as usual. They visited the Bracketts at Limerick, Maine, and did a bit of fishing along the Maine coast, also visiting Mt. Desert Island with a stop at his nephew's camp on Grand Lake Stream. Later they made another trip east to attend a wedding. In the fall, they took a short trip to Missouri, visiting Bronson in the Ozark country and around the area where Harold Bell Wright wrote his *Shepherd of the Hills* and *Million Dollar City*,—nothing too spectacular. They spent Christmas at his daughter's home in Scotch Plains, N.J. Future plans include a trip to Mexico with the group of photographers they accompanied on their trip last year to Colorado and Arizona. Looks like Larry still keeps quite busy with all that running about. . . . **Al Harkness** of Providence writes that his health is satisfactory and that he still spends five days at his architect's office, but says he expects to "close up shop" some time this year. He has one son who is retiring from foreign service and starting to teach at Fletcher School of Law and Diplomacy. Another son is a member of T.A.C.—The Architects Collaborative of Cambridge, Mass.

Chester Dows had a good summer with his wife, Frances, at their lake cottage near Cleveland. He says the water is still clean and they could enjoy the swimming; no pollution. There is, however, much erosion in the vicinity, damaging some houses nearby. Chet had the foresight of this possibility and built a sea wall several years ago. Chet says he decided to reduce the size of his garden at the lake this year and now has a joint garden with a neighbor. It does get more difficult each year, eh, Chet. . . . I was pleased to receive a sympathy note from **Les Duke**, another classmate who still works. He is still Manager of the Water Co., in Paramount, Calif., a city of 35,000. Les says his health is excellent as is that of his wife. He is justly proud of his record of 100 per cent attendance in the local Kiwanis Club where he has been a member for 42 years. Les says that they have two daughters, who presumably live nearby, as he sees them often.

I received a fine note of sympathy from **John Hall** who says he has no special news at present but promises a letter soon. Thank you, John; we always enjoy your contributions. . . . **Harold Mitchell** writes that his only news is a recent award he received from the New York State Conservation Council as their annual selection of Wildlife Conservationist which, of course, pleased him greatly. Our congratulations, Harold . . . **Paul Tyler** has sent me his impressions of his trip to Disney World near Orlando, as promised. I will quote, "We arrived in late November on a day less busy than usual and did not have to wait at any attraction more than a few minutes. We were told, however, that on occasions the 14,000-car parking lot is jammed, and access roads are blocked for ten miles with cars bumper-to-bumper. Disney World is vastly larger than Disneyland in California, but is otherwise much the same. The focal point is a whimsical Cinderella Castle and the various attractions are arranged in segments of a surrounding circle. The entire tract contains 27,500 acres, only one tenth of which has been developed, including two large expensive hotels. We took a monorail from the parking lot to the fringe of the entertainment area. A black smoke belching locomotive hauls an old fashioned train in a circle around this area. An old style steamer carried us on a jungle cruise past hundreds of wild animals, all lifelike and some animated. "Bell Telephone sponsors a feature that impressed us most. A simulated tour where one is surrounded by a three-dimensional motion picture showing highlights of America, concluding with a five-minute tour of Washington, D.C. We had never seen such a feature so convincing or comprehensive. The 'Hall of Presidents' resembles Independence Hall, in which is presented a series of animated tableaus featuring most lifelike scenes acted out by models of all our chief executives from Washington to Johnson. Space will not permit descriptions of the many other features."

Walter Green, who is now approaching his 86th birthday, writes from Florida, "Although I am still feeling quite well, the doctors say that I have diabetes, arthritis, two cataracts, glaucoma in each eye and the Lord knows what else. I would otherwise not know that I have any of these problems. I make tests daily with Testape paper but they show no blue or green color. I also take a daily pill for arthritis and two pills for a sluggish thyroid gland. In addition, I must put four drops of liquid in my eyes each day. So, I have little time for other activities. Such is old age. I have stopped driving a car and have cancelled various club activities. I stay home with 'mother' who is a big help and comfort. We celebrated our 59th wedding anniversary last June. I did visit Disney World twice—a nice place to spend money and do much hiking. I saw Apollo 17 rise over an orange grove and heard the roar from the Cape, 30 miles distant. I continue to take a walk of about a mile several times each week." Keep up the good work, Walter. More and more of us are getting in a similar condition during these golden years. . . . And from **Nelson Breed** of Wilton, Conn., "After having my own office for 50 years, I am retiring from the practice of architecture. However, my general health is still good and last fall I readied my garden for next year. My wife and I spent the summer as usual in my cottage at the north end of Block Island, R.I. This area is the best on the eastern coast for migratory bird observation. I feel that nothing detrimental should be done to interfere with this natural wild life refuge. So, I have given some 35 acres to the town with restrictions which should insure that it will remain permanently as an excellent sanctuary. We spent Thanksgiving with relatives in Mansfield, Oh., and our trip on Route 80 was a beautiful one. We plan to leave in late February on a trip from Miami to the Virgin Islands, Haiti, Martinique, Barbados, Guatemala, and Yucatan."

I have a note from **Vincent MacDonough**, his very first, which pleased me. He says, "I have been a widower for 25 years and live here alone in Watertown, Mass. I have been retired for 13 years. My health is reasonably good for which I am most thankful. Please give my best wishes to our classmates, particularly to those in Course X." . . . **Fritz Shepard** says, "Life for Betty and I is very quiet. Fortunately, the heart attack which I suffered last year has not proved serious and I seem to be about as good as before. We get out for short walks on good days and have stayed pretty close to home since we returned from Marblehead last fall. We keep busy with our four grandchildren who have made their home with us since the death of my son last summer."

It is my sad duty to report the deaths of former classmates. On January 9, **Willis Salisbury** of Minneapolis died suddenly in his sleep from a heart attack. Willis was one of our most active classmates and one of our best correspondents. He took a long trip each spring to several foreign countries and always visited with some of the friends he had made throughout the world. He lost his wife several years ago but had two sons, a daughter and two grandchildren. For 60 years he was active in the Methodist Church, was one of the founders of the Big Brothers Organization, the Better Business Bureau, President of the Athletic Club and an M.I.T. Educational Counsellor. We shall all miss him greatly. . . . **Luis Gonzales** died in San Juan, P.R. on August 2, 1972. He had been an invalid for several years. . . . **Freeman Pretzinger**, a Course IV special and still practising as an architect until recently, died on October 9, 1972 in Dayton, Oh. . . . **William A. Rhodes**, Course VI, of Bronxville, N.Y., passed away on December 15, 1972. Bill spent his career with Bell Telephone Labs, working on research and design. He was also a writer and philosopher, and published a book on Humanology. He was a frequent contributor to our column and his comments were always interesting. He is survived by his wife, Louise, one daughter and five brothers and sisters. Louise advises that The Telephone Pioneers of America are planning a gift in his name.

Walter Triplett, Course III, died at his home in Monterrey, Mexico on November 21, 1972. He spent his entire career with the American Metal Climax and predecessor companies as a geologist and later in highly specialized ore, particularly in "marto" type lead-zinc formations. He was a widower of some 20 years but returned each year to Michigan to visit his relatives. A memorial in his honor has been established at the American School Foundation of Monterrey.

You have undoubtedly received a letter from the Alumni Association that they are making plans for a Mini-Reunion of those classes not due for a regular reunion this year. It will be held to include Alumni Day on June 3, 1973. If interested, please let me know promptly and

I shall obtain more data and details. Presumably, we would stay at McCormick Hall for at least two nights and attend all festivities including the Boston Pops and a Class Party.—**Ray E. Wilson**, Secretary, 304 Park Ave., Swarthmore, Pa. 19081

13

Well, the holidays have come and gone. We have enjoyed several Christmas and New Year's festivities, starting with the Fall Dinner Meeting of the M.I.T. Western Maine Club, November 15, at the Holiday Inn in Portland, Maine. A get-together social hour was very enjoyable where we renewed several friendships and met many new acquaintances. The dinner was very well served. Dr. Murray Eden, professor of electrical engineering at M.I.T., gave a very interesting talk on "The Application of Electrical Engineering to Medical and Biological Problems."

Roz and I spent Thanksgiving and several days with her sister, Louise Rickard, in Portsmouth, R.I., together with her brother Robert and several of the members of his family. During the Christmas and New Year's Holiday we had several reunions with "summer neighbors," including a "sunrise" wedding of the oldest daughter of our friends from Gettysburg, Pa., followed by a reception at the Shawmut Inn, Kennebunkport Beach. We have talked by phone to Paul Weamer, '49, of the Alumni Day Committee, who is assisting us with the plans for our 60th Reunion in June. We are pleased to learn that **Warren Gentner**, the **Dave Nasons**, the **Gene Macdonalds**, **Fred Kennedy**, and the **Bion Pierces** hope to attend our 60th Reunion. The Capens received Christmas or Holiday cards from a number of our classmates and friends, including Mrs. **Prescott Kelly**, Mrs. **Arthur Laurence Brown**, and one from the Staff of *Technology Review*. We thank you all for your good wishes.

We are indebted to **Harold Crawford** for a clipping announcing the death of **William F. Herbert**: "William F. Herbert, M.I.T. '13, died on April 22, 1972, in Oakland, Calif. Mr. Herbert was the first licensed architect in the city of Santa Rosa, was a school inspector in Compton, and helped develop the state's first building code. Among credits given to Mr. Herbert was supervising architect in 1925 on Santa Rosa High School, and the designs of the Sonoma County Fairgrounds' main pavilion; Cloverdale High School, the fire station located on A Street, Parkside Elementary School in Sebastopol, and many early homes in the Santa Rosa area. He held positions in civil service in the nation's capital after leaving Santa Rosa, was a school inspector in Compton, Calif., then was building inspector for seven years at Edmonds, Wash. He retired to Berkeley, Calif., and died in an Oakland nursing home." We are sending a sympathy card to Bill's family.

We have received an interesting notice of the 25th anniversary of the founding of the M.I.T. Club of Mexico City, March 15, 16, and 17, 1973. If any of the Class of '13 are interested in this attractive celebration, write to the M.I.T. Club of Mexico City at Apartado Postal 31, Fracc. La Florida, Edo. de Mexico, Mexico. . . . It is with a great deal of pleasure that we have learned of the marriage of Nathaniel M. Sage '41, and Dorothy Anne Blair, and we quote from a Boston newspaper: "A reception at the Lord Jeffrey Inn, Amherst, followed the Christmas Day wedding of Miss Dorothy Anne Blair and Nathaniel McLean Sage, Jr., at the First Congregational Church, Amherst. The bride, daughter of Mrs. Daniel Temple and the late Earle F. Blair of Amherst, has been personnel officer at M.I.T. The ceremony was performed by Reverend Charles Farrell. Mrs. Peter Bulkley of Westfield was matron of honor for her sister. John Case of Harrisburg, Pa., attended the bridegroom, who is the son of **Mrs. Nathaniel McLean Sage** of Brookline and Whitingham, Vt., and the late Mr. Sage." He received his B.A. and Ph.D. degrees from M.I.T., where he was later Associate Director of the Division of Sponsored Research.

Hope we shall greet you at our 60th Reunion.—**George Philip Capen**, Secretary and Treasurer; **Rosalind R. Capen**, Assistant Secretary; Granite Point Rd., Biddeford, Maine 04005

14

Two excerpts from a letter that **Johnny Leathers** wrote me months ago should have been in our Class news long before now. "Early in July, I attended a sales meeting in New Jersey, making the entire trip of 365 miles in impenetrable traffic, for it rained torrents without interruption. About the time that I crossed the Tappan Zee bridge, a big tractor and trailing box were driven right off the bridge into the Hudson, and never reported until the driver swam ashore and asked the White Plains police if his tractor had been pulled out yet. (They said, 'What tractor?!') Following an equally tedious, but drier return trip, home and garden were synonymous with Paradise.

"When you next visit Boston, perhaps you, Lois, and Deborah would enjoy a ride in the automobile of which a picture is enclosed. It has a 5 horsepower engine, planetary transmission by a single chain, and 28 inch x 3½ inch tires. Most important to me, however, is the fact that it is virtually a duplicate of the carriage on which I learned to drive in 1904, so it now stands in our old barn, registered, and always available. If you haven't recently ridden 'En plein air,' a ride is an experience." I agree, and perhaps should make the trip to Hingham in my own antique, a '67 Corvair which still runs, and steers, beautifully, as did its '60 Corvair predecessor.

H. S. Busby writes that his interests are now mostly in close contacts with his family, and that his grandson is a good pilot and flies him back and forth to Dallas, where most of his children are centered. Bus adds, however, that he's interested also in regional history and in the history of mathematics, and has a fine collection of source material in the latter field. . . . On his Christmas card, **Henry Aldrich** wrote that, after a family visit in Arlington, Va., he and Helen were going to Florida on the Auto Train, to spend the rest of the winter in Naples, as they usually do. . . . **Ray MacCart** wrote in January that he and Virginia were also going to Florida on the Auto Train (for the second time), but are thinking of spending their winters after this one in their comfortable Washington apartment.

Ray Dinsmore sent me a clipping from a December newspaper which tells of the presentation of the Akron Dental Society's Award of Merit for Professional Community Service to **Walter Keith**. In presenting the award, the President of the Society said it was made because of, "your support of dentistry and your efforts over the years to make our jobs easier by providing us with new and better materials to work with, and maintaining a company that adds 90 jobs to our community." . . . **Jim Reber** wrote in December, "All is well in Texas. We spent two weeks in Delray Beach last winter, two weeks in Bermuda last summer, and three months in Auburn, N.Y., returning to Houston in October. Hope to see you at our 60th Reunion."

The Alumni Fund has recently learned of the death of **Marquis S. Smith** on August 8, 1971. The Class Secretary's record card shows that he was with us in only our freshman year, that he lived mostly in eastern Massachusetts, and in Marblehead since 1959. The record shows also that he married Edith B. Coombs in 1916, and had two children, Patricia and Constance.

New address: **Harold A. Mayer**, 611 S.W. Tenth Ave., No. 307, Portland, Or. 97205. —**Charles H. Chatfield**, Secretary, 177 Steele Rd., West Hartford, Ct. 06119

15

The many Christmas cards we received from widely scattered classmates and their families were warm reminders that the joy of Christmas is a good deal in living with the memories of fine old friendships. There were many pretty and unusual cards. A card signed by the *Review* Editor and his staff makes me feel that they really do care. . . . **Alice Anderson** was on a winter cruise. She keeps busy with local civic work and an interest in Beaver College. . . . **Bob Welles** wrote on a colorful card from Kon Tiki in French Polynesia, "I am here with my daughter and granddaughter for the Christmas holidays. It's strange to hop into long warm summer days. We live in grass shacks (rather sophisticated ones) and relish the tropical fruit and surf breaking over the coral reefs." . . . Early in the winter **Larry Landers**, **Boots Malone**, and **Hank Marion** had cardiac troubles. I am glad to report they are all much better and getting along well.

The 1915 Class will hold its Annual Class Cocktail Party and Dinner on June 4 at 4 p.m. at the M.I.T. Faculty Club. Notices will be sent later.

We had long distance cards from Carmela and Gustavo Gross, '50, Guayaquil, Ecuador, and Margaret and Gilbert Mar, '51 Tapeii, Taiwan. From friends of the Class—Mary Scully and Frank's sisters Gen and Florence and his brother Jim; May Sheils and her family including Bill and his wife Jeannette who always attend our class parties here; Elizabeth Baker, Margaret Runels, Peter and Jean Murphy with signatures of Harry's six grand children; Jean and Jack Mohr, '50; Vi Proctor (Dix was '17); Fannie Gfroerer (Herb was '16); Molly Swift; Edna and Frank Stubbings ('17); Janet and Louis Verveer, ('30). Ellen and Ellis Brewster ('13) sent an original card with sketches of their eight great grandchildren. It's nice to have all these interested friends.

In the space limited to us by the editors, I'll give you, alphabetically, as many of the card messages as I can and complete them in next month's column. **Mary Plummer Rice** writes, "I am looking forward to my visit to the Fiesta in Mexico City and the Amita Reunion at M.I.T. on Alumni Day. Do you remember our stunt the night before graduation? I had the part of Ellen Swallow, the first woman to graduate from M.I.T., in 1873. This year there will be an observance of her 100th anniversary." Keep it up, Mary. . . . **Phil Alger** is planning to write a new book on his and his family's personal experiences. He is looking forward to our 60th Reunion. . . . **Whit Brown** felt his move to permanence in Anna Maria, Fla., was more of a task than he had anticipated. . . . **Jerry Coldwell** still spends a few days each week at the Roosevelt Hospital in New York, but, he says, it takes him longer than formerly. Age, Jerry? . . . **Jack Dalton** left Boston for Winter Park, Fla., not feeling too well, but he says his patience is being rewarded with better health. . . . Helen and **Ken Boynton** had a long motor trip thru New England and New York State during the height of the famous fall coloring up here. . . . Beulah and **Earle Brown**'s card was a print of President Eisenhower's painting, "White Church in the Country." . . . Florence and **Harvey Daniels** are back in Del Ray.

Otto Hilbert, Corning, N.Y., notes that, "We had a terrible experience from the flood last June. We were lucky enough not to get any water damage. The help received from many outside sources to get back to normal was truly remarkable." . . . Esther and **Ken Johnson** are in good health. They have three grown grandchildren. . . . Marion and **Vince Maconi** say that they "seem to be joining the slowin' down club and perhaps will have to fly South or West instead of driving." . . . Lucy and **Harry Murphy** found the *France* with its 1000 passengers just a little bit too big for their cruise. . . . **Frank Murphy**, St. Augustine Shores, Fla.: "I had some surgery in June but am finally back on my feet. It has taken me some time to master riding a bicycle, entailing many falls. There's a nice recreation building here with tables for cards, pool and ping pong. There are ten shuffleboard courts, a huge swimming pool, two barnyard golf courses, and a fishing pier on the Matansas River, which is part of the inland waterway. I have seen snow only on TV." Sounds as though Frank is in one of those pleasant and comfortable senior citizens havens down there.

Ben Neal's Christmas wish: "With plenty of bottled pleasure and a good gang of old friends to enjoy it."—ah me! Among the many notices I am receiving about 80th birthdays, Ben wrote that he is celebrating his with a party at the Tuscarora Club Lockport on January 30. I'd like to be there to toast the years with Ben, a great guy. . . . **Henry Leeb** invites any classmates near his Walnut Hill Farm, Gladstone, N.J., to drop in to see him and his guernsey herd. . . . While in Boston visiting his son, **Stan Osborn** phoned. It's always good to talk with any of you when you're here in Boston.

Sam Otis, 516 Walnut St., Winnetka, Ill., is working on his invention, "an automatic check-out machine for Super Markets." . . . **Doug McMurtrie**'s widow, Madeleine, died in Berlin, N.H., November 11, 1972. She was a native of Toulouse, France. . . . **Clifton N. Jacobs** died in Walnut Creek, Calif., November 9, 1972. . . . Next month's column will carry the story of the Boston Class lunch at the M.I.T. Faculty Club here on April 13. Until then—all the best.—**Azel W. Mack**, Secretary, 100 Memorial Dr., Apt. 26A, Cambridge, Mass.

16

Just keep in mind that our next Reunion, the 57th, is to be held in the ever enjoyable Chatham Bars Inn in June; more later. Not long after the last reunion, Hildegarde and **Jap Carr** had seven feet of water in their Wyoming Valley (Wilkes Barre) apartment, dumped there by Hurricane Agnes. Fortunately, they were at Buck Hill Falls, but Hildegarde's sister "just got out of the apartment in time and was missing for six days, but safe. All the furniture had to be thrown out and plasterers, painters, wall-paperers, electricians and carpenters had been working for almost five months, with no end in sight" as Jap wrote in November. "We were luckier than most people, at that. You read about it in the papers, saw it on television, but the only way to know how it was, was to see it." In early October, Jap attended his 60th Class Reunion at Mercersburg Academy. "As an old tennis player you well know how anxious I am to try my tennis wings. The doctors say it should be OK and this is the week I expect to try it. My indoor tennis center at Tech had a very successful first year and is already completely sold out from 8:00 a.m. to 11:00 p.m. daily for the school year (1972-73)."

Charlie Cellarius tells of a Caribbean cruise in February a year ago and a September trip to Europe with his sister. "We spent a week in Morocco, two or three days in the Canary Islands, and two weeks in France where we again revisited the Riviera, the Chateaux district, and Paris." In July, Mildred and **Art Shuey** flew to New York to cruise on the *Olympia* to see the total eclipse of the sun. "Everybody had cameras, telescopes, binoculars and were serious enough to go to three or four classes a day. The eclipse was breathtaking and with a clear sky we saw all, one minute and 36 seconds of it, for our ship was steered by satellite reference to the only cloudless space in a day's sailing." They shipped home their eclipse hardware and summer clothes and flew on to Prestwick, Scotland. Then followed visits to Campeltown, the home of the Fergusons, Art's mother's family, Glasgow and Edinburgh, then by train to London and travels to several places including Oxford, Winchester, and Stonehenge. Later in Colorado, Art caught the biggest rainbow that he ever caught in the U.S. on a little number 16 blue bottle fly he got in Scotland. . . . **Victor Dunbar** spent eight weeks traveling by ship from Spain to Italy and Greece, then to Switzerland and Holland, and finally a little travel with his son in England. . . . Gladys and **John Fairfield** took part in a charter-plane trip of several colleges in Greece around December. John has rated the places and events covered like this: 1. Acropolis, 2. Delfi, 3. Mykarai, 4. Cruise, 5. Archeology Museum. His ratings are, he says, influenced by his hobby of Greek. "Acropolis is a wonderful sight, unforgetable, refreshing in every light, when seeing it over and over. All are now forbidden to climb inside the Parthenon—rough climbing, stone worn smooth by so many pilgrims."

Willard Brown of Santa Barbara enthuses on the interesting show put on by Bill Bergen, '37, of North American Rockwell at the N.A.R. Space Center in Downey. Two scientists aided Bergen in telling all about Apollo 17, the orbiting space lab (for which N.A.R. has a basic contract), and the coming link-up with a Russian orbiting satellite. At the talk, there was a complete mock-up of the Apollo 17 capsule and also of the space laboratory. Willard's Christmas card included what appear to be round-trip tickets to the Moon, Mars, and Venus. What are we offered? Willard reports good health for Dorothy and himself and continued busyness as Vice President of the Grove Lane District Improvement Association of Santa Barbara. . . . In the *New York Times* of December 7, we find a letter to the editor from **Walter D. Binger** on the subject of Military Justice: "To the editor: The finding that military justice is faulty, referred to in your editorial of December 5, brings to mind the terse definition of the French statesman Georges Clemenceau: 'Military justice is to justice as military music is to music.' "

In late November, **Vert Young** of Bogalusa reported being home from San Francisco "sporting an artificial hip joint" that had been planned for some time. Things are progressing well and Vert adds: "Did you ever hear of sympathy between dog and master? My springer spaniel, Rocky, has been in the vet hospital with a broken hip." . . . **Howard Claussen** of Cotuit reported in November that all was fine with him after his illness of some months back. His activities are curtailed but apparently he has learned the new limitations. He and Florence are proud of son Frederic's election as Register of Probate and Howard sends a picture of their yacht "Booh-Bah", a twin diesel job

"with about everything except radar and that will be installed in the spring. Has twin radio-phone, electric refrigerator, T.V., swordfish pulpit, and sleeps six comfortably." We regret exceedingly to report that not long after these encouraging words were sent to the *Review*, Fred reported that his father had trouble with breathing, was taken to the Cape Cod Hospital, and died on January 13. . . . The **Will Wyldes** have taken that more-or-less final step of selling their house in Stamford, Vt., and have taken an apartment in Williamstown, Mass., for the four-and-a-half months they expect to continue staying in the North each year. Now their permanent home for the bulk of the year will be in Bradenton, Fla. All of this he cites as the only news of importance other than the fact that they now have three great-grandchildren as compared with one a year ago.

Elbridge Devine of Pelham, N.Y., reports significantly: "Everything now is in the 50's. Fifty-two years married to the same wife and both still going fairly well. Fifty years living in and owning the same house. Children are all just or approaching 50!" . . . Word from Hazel (Mrs. **Bob**) **Crosby** in Sierra Madre, Calif., says she wishes all we Easterners could enjoy California weather for she hears our winter had started early this year and knows what that can be like. She adds, "Easier on the old bones out here!" And Kay (Mrs. **Irv**) **McDaniel** also writes from Laguna Hills, that all goes well, that last summer she saw the whale, "Gigi," released by "Sea World" to join its own kind, and that her Thanksgiving dinner included among its guests, Admiral and Mrs. Bill Sullivan, '17.

Dick Fellows in Indio, Calif., says they, like nearly everyone who can, leave in July and August when the temperature runs from 110 to 120 degrees. "This year we spent several weeks at Idylwild in the mountains about 30 miles from here where the temperature averages 30 degrees cooler." They spent some time in Oakland and in Portland, Ore., visiting first their son, and then their daughter with the several grandchildren. Says they now have six great-grandchildren and wonders how many other '16ers have as many. . . . **Arvin Page** of Winston-Salem adds a note that gives a plus to North Carolina as a place for retirement. We used to have trips down to his home town when the Nike missile was being built. Says Arvin, "The ranks of the unemployed here are constantly being augmented by retirees from Bell Labs and Western Electric, most of whom were far from pleased when they were transferred here from various locations in the North. Now, after living here for several years, the majority feel there is no better place in the country in which to spend their remaining years. During the past two years I don't think I have ventured beyond the city limits of Winston-Salem."

Larry Knowlton of Cumberland, R.I., writes that he now lives alone, "taking care of my house and grounds, with occasional trips to visit my daughter in North Carolina and my son in Houston, Texas." Larry, who first got a degree at Harvard, is one of six living '16ers who were taught to use the CI-scale on the slide rule by Donk Woodward in Lowell High School; the other five are **Ralph Fletcher**, **Howard Hands**, **Ed Jenkins**, **Earl Mellen**, and your Secretary. . . . **Val Ellicott** of Baltimore, a public health man "inspired by Professor Sedgewick," as he says, "dabbles through our County Aging Commission, in efforts to improve patient's care in nursing homes, a hangover from my pre-retirement life in public health." Says he has no big story but one thing he has enjoyed is that of organizing a club of retired persons. As a result, his church and other churches have set up a Fellowship Club which meets Friday mornings with an attendance of about 45. His job now is to get an interesting program once a week.

January's 1916-17 New York luncheon was attended by 16ers: **Walt Binger**, **Herb Mendelson** and **Len Stone**, plus 17ers: Bill Neuberg, Dick Loengard, and Clarence Seely.

Finally, just keep your willing-to-work Secretaries busy and out of mischief by writing a little, but writing often to—**Harold F. Dodge**, Secretary, 96 Briarcliff Rd., Mtn. Lakes, N.J. 07046; and **Leonard Stone**, Assistant Secretary, 34-16 85th St., Jackson Heights, N.Y., 11372

17

Thanks to the unfailing support of all of you, three of us, **Al Lunn**, President, and Class Agents **Ray Brooks** and **Stan Dunning**, are recipients of handsome tokens of the Alumni Fund Board's appreciation for the 1972 results. These were accompanied by a cordial letter from President Wiesner expressing the gratitude of the Institute for the response of the Class of 1917 to the Institute's needs. He wrote in part, "Personal giving, as exemplified by the Fund, is the lifestream of private education. I hope that you have derived as much satisfaction from your accomplishments as we have in knowing the depth of your support." The token is an attractive 2 by 2 by ¾ inch Carrara marble base with 1½ inch metal seal depicting an M.I.T. scene with inscription. Your support of the Buzz Aldrin Scholarship Fund led by Al Lunn and the general support of your Class Agents with specified and unspecified gifts make the three of us not only appreciative of the tokens but of your cooperation and we thank you.

Dud Bell has not been known to sit back and wait for things to happen. With much suffering for a long time with ankle pains he has sought relief at several clinics and by various means. Here is his present venture which will be watched with interest and hope, "Last Tuesday, December 5, I got to New York and had my first acupuncture treatment with four or five more to come. A needle was inserted below the knee in each leg—about 2½ inches long. A machine on batteries with extended wires was attached to each needle and vibration was produced. The only pain I felt was in the ankles. About one half hour was the treatment. Already I feel much better. If you have any arthritis, keep acupuncture in mind." It had been hoped that there would be further word from Dud for these notes but delays in follow-up treatments because of New York medical laws postpones word.

Our star reporter relays two contributions. One is a suggestion and invitation from Betty Hulburd that possibly 1917 would consider a reunion meeting in her Meriden, N.H. area (Lebanon-Hanover). The invitation will be seriously considered and is appreciated. The other item referred to a story in the December Reader's Digest, "Fun on the Campus". It quoted from an incident with Dr. Frank Aydelotte, the then President of Swarthmore. Aside from the story it brought to mind and will, no doubt, to many others who had Professor Aydelotte in sophomore English, what an extraordinary teacher he was and the privilege that it was to sit under him. . . . It is good to learn that **Al Moody**, after a stroke in May, is allowed to drive his car again. Also that **Frank Butterworth** passed his Mayo Clinic check-up very successfully. . . . The navy still rates high with the **Webster Gokey** family. Web, Jr., is in command of the Ship Repair Facility at Guam and Ensign James Gokey is at Pensacola. Web, Sr. reports that Allene is making slow but encouraging progress from her stroke of last spring. . . . A note from **Stan Chisholm** sends his greetings to his Melrose and Newburyport friends.

There is to be an added feature at Alumni Day next June. A mini-reunion time for classes will precede the buffet Sunday afternoon, June 3. Depending on the numbers attending individual class gatherings or group-class gatherings will have their own locations. It sounds interesting and details will follow.

It is regretable that the death of **Radcliffe Stevens** has to be reported. Many will recall him as the anchor-man of our tug-of-war teams and as a 25-year Educational Council member. He died in Elgin, Ill., on December 22. Although he joined the army, he was taken over by the Submarine Signal Corps and served there for duration. He was with the Elgin Watch Co., for many years and then purchased the Elgin Manufacturing Co. in packaging machinery. . . . A 1927 alumnus kindly and with regret sends word of the death of **Dexter Tutein** on December 13 at Mallorca, Spain where he had been living for several years.—**Stanley C. Dunning**, Secretary, 6 Jason St., Arlington, Mass. 02174; **Richard O. Loengard**, Assistant Secretary, 21 East 87th St., New York, N.Y. 10018

18

Winter is the time of hibernation, the truth of which is indicated by the paucity of news from all of you. I decided to partially fill this void by spending a little time at our Alma Mater and here are some impressions to report to you:

The mood is calmer. In 1968-69, decorations on the walls were macabre and ghoulish in many places. Now they are dignified, pleasant and far fewer in number. The activists who threatened and, occasionally, exercised violence have retreated. Today's students are serious and have their sights on their careers after

matriculation. Maybe the current unemployment situation is making its influence felt in this area. New studies, particularly in health engineering and biology are becoming most popular and are enrolling the largest percentage of the incoming classes. All in all, I can report that students, faculty and administration are working together well. May it continue to be more so.

I had been wondering why we had not heard from **Gretchen Palmer** for many months. She was a most loyal member of our Class—attended every function that she was able to make, even at a personal sacrifice. She probably knew more of us during our undergraduate years than any other member and was, without question, the most warm-hearted and beloved by us all. It is with great sadness that I received the attached letter advising me of her death on May 22, 1972:

"Although I read your '18 column in every issue of the *Technology Review*, I have not noticed an obituary on the death of Gretchen A. Palmer on May 22, 1972. I am a very close friend of over 55 years and didn't know of it until mid-October. In mid-January Gretchen was in a hospital near her home in Princeville, Ill., after suffering a series of heart attacks. In December 1971, she had driven a friend to Florida and was nearing home after New Year's 1972, when the first attack occurred. However, she did well, I was informed in late February, and was about to be transferred to a nursing home. I never had a reply to any of my cards or notes. Finally a post card came from a young acquaintance in mid-October informing me of Gretchen's death and burial in Norwalk, Conn.

"Gretchen was a very active member of your Class in her undergraduate days, (my husband was a member of the Class of 1917), and she kept a keen interest in the Class over the years. She attended most of the reunions, in fact, she stayed with me en route to the June Reunion in 1971. In her later years she gave her unbounded energy to the work of her church. We all suffer the loss of a lifelong devoted friend. Sincerely, Dorothy M. Proctor, widow of Colonel J. Worthen Proctor, '17."

Here is news from Eleanor and **Sidney Blaisdell**:

"Our second Christmas in Florida is approaching and in the intervening year we have sold our home in East Greenwich, given away and disposed of many of our belongings and filled every nook, cranny and closet in our apartment with the balance.

We returned in September via the Auto Train and enjoyed the trip and experience very much. It was well thought out and pleasantly executed. Life at Shell Point Village is a continual round of activity, trips, travelogues, exercise class, shuffleboard, golf and bridge for health and amusement. On the serious side lectures, classes and various church activities. The number of people here has doubled since we came last year and will increase about 150 more by the end of February.

Our children are very busy, Betty in New York, Bill and Ruth keeping a quiet house in Barrington, while their daughters are away, Ellen is a junior at Simmons College and Marcia a freshman at the University of Colorado at Boulder. We are enjoying life here."

A welcome letter from **Harry LeVine** tells of his visit to California:

"Eva and I just returned from California where we visited both our son and daughter and their families. The main purpose of our trip was the Bar Mitzvah of our daughter's fourth and youngest son. Her oldest son Neil Colvin, '70, is a real whiz on computers. He is doing graduate work and working part time at Federal Reserve Bank in Boston and is really doing far better than I could do at his age.

Our son Burton, '49, is an electronic research engineer at Naval Electronics Research Center in San Diego, where he lives with his wife and one daughter.

"Due to difficult eye problems I have been forced to resign from my long-enjoyed and greatly-loved job as regional chairman. My successor has been understudying me to take over later this year.

"Eva and I both send our love to both of you, and all our friends and look forward to seeing you all in June, God willing."

For your information, our 55th starts Friday, June 1 and continues through Monday, June 4. Reserve the time now and be with us. More details will follow soon.

An air mail card from Gladys and **Len Levine** in January located them on the *SS France* calling on ports in the West Indies for a winter vacation. . . . A short note from **Fred Philbrick** indicates we will see him at our 55th in June.—**Max Seltzer**, Secretary, 60 Longwood Ave., Brookline, Mass.; **Leonard Levine**, Assistant Secretary, 519 Washington St., Brookline, Mass.

19

Your Secretary spent Christmas with his two daughters in Boston and while there saw Elizabeth and Julian Howe, '18, and **George Michelson**. Phone calls failed to reach others. George is still active in the construction business. Letters were received from **Eleanor Muller** and **Winnie Sorenson**. Winnie writes, "Sorry had not been feeling well for sometime but we did not realize he was in any danger, so it was quite a shock to all of us." We hope to see them at our 55th Reunion which by the way is soon coming.

Will Langille's note "As Reunion Chairman am starting activity for 55th Year Reunion in 1974" sounds good to all of us. . . . Christmas greetings were received from Iva and **Everett Doten** with a note saying "Decided to sell our home and have moved into a small apartment in the Whittier Towers right in Detroit." . . . Also a note from **Nelson A. Bond** "Twenty-five inches of snow in Schenectady in November, breaking all records." . . . **Jim Reis** writes "This has been a pretty quiet summer after my return from Indonesia but have managed to make a couple of short trips, one to Yellowstone and Jackson Hole and the other to Monument Valley and the Navajo Indian Reservation. Also went fishing to my old stamping grounds in Ontario where I have been going for some 40 years." . . . A card came from **Don Way** and I expect to see him here shortly as he and his wife visit his wife's brother here in Boynton Beach, Fla.

Addresses from the Alumni Association include Professor **James Holt**, 60 Harrison St., Duxbury, Mass. and **Horace D. White**, Rt. 1, Box 51, Vandalia, Ill.

Colonel **William H. Bassett, Jr.**, writes "Twenty-two years ago I had the privilege of obtaining 40 boats from the Japanese in Kobe port in accordance with orders from General MacArthur. We reinforced these 20-feet wide, 30-feet long boats with 12 inch x 12 inch timbers and had them ready in five days. Eight boats had semi-diesel engines and towed four of the dead barges. These were the pontoons for the Inchon invasion. . . . **Edward F. Richardson** writes, "My wife May and I now live in a first floor apartment after selling our old home. The new address is 53E Market St. Apt. 2, Bethlehem, Penn. 18018. . . . Had a letter from **Ralph Cartwright**. His address is 75 Atlantic Ave., North Hampton, N.H. 03862.

Alex Wiren "Until the end of October by special request of Dowling College, Oakdale, I was there to assist in completing arrangements for the $6 million construction program for which earlier I was helping to obtain government grants. This will include a library, academic facilities building, and a student residence for 200." . . . **Francis A. Weiskittel** writes from Baltimore "My youngest son, Sturtevant F., now studying classics at Corpus Christi College, Oxford, England will be married in Kingsville, Texas to a Corpus Christi, Texas girl on his 26th birthday which is December 30, 1972. So I may yet become a grandfather. As for myself—no change except the usual infirmities that go with age 74. See you at the 55th Reunion." . . . Your Secretary is planning to be at Wellesley at the Treadwell Wellesley Inn January 7, 1973. Then a trip to Norway, Sweden, Finland and the U.S.S.R. until the middle of July. August will find us in Chalk River, Ontario, Canada.—**E. R. Smoley**, Secretary, 50 East Rd., Delray Beach, Fla.

20

An unusual and noteworthy spate of Christmas and New Year greetings gladdened the heart of your ancient Secretary. Norrie Abbott, Ed Ryer, Dick Gee, Buzz Burroughs, Lee Thomas, Bill Dewey, Ming Pai, Jim Gibson, Chuck Reed, "Toots" Kinghorn, Frank Badger, Al Burke, Harry Kahn, Bob Bradley, Ned Murdough, Stan Reynolds, Dorothea Rathbone, and K. B. White's cards and messages were gratefully received and are hereby acknowledged. . . . **Chuck Reed** tells me that he visited his son, Edwin, '45, his wife and three of their grandchildren in Houston in November where he and Ilse celebrated their 50th wedding anniversary. (Congratulations Chuck!) The Reed's other son, David, and his son visited them at Thanksgiving. . . . **Dick Gee** reminds us that they will once more be in Florida this season. . . . **Frank Badger** says that **Foster Doane** has been spending several weeks at their place in

Hollywood, Fla. Frank says he hopes to get to Boston for the next Alumni Day. . . . **Toots Kinghorn** relays the good news that his eye operation was successful and he now has reasonably good vision. He and Elvira live at 200 Glenwood Circle, Monterey, Calif. . . . Barbara and **Bill Dewey** are holding forth for the winter at 625 Capri Blvd., Treasure Island, Fla. . . . **Bob Bradley** reports that they spent a white Christmas at the farm in South Dartmouth with the family. Bob and Ruth are presently at 2613 N. Ocean, Delray Beach, Fla. A cheerful note from our dauntless **Dorothia Rathbone** says, "With the rest of the retired people, I am 'busy' just enjoying the things I like and want to do, such as walking around Providence to see the 'new' town evolve, and taking a run up to Boston now and then to do the same. The co-eds have a reunion this year to celebrate 100 years from the time the first co-ed invaded Boston Tech. It seems I can almost remember those days—long enough—except that I like old age, should have thought of it before."

A welcome letter from **Joe Margolis** gives the news that he and Ruth have finally settled in Hollywood, Fla., at Sea-Air Towers, 3725 S. Ocean Drive. They intend to stay there ten months of the year with the remaining summer months visiting their two daughters and their families, one of whom has a husband who is chief neurosurgeon at St. Vincent's Hospital in New York City. Their summer place is at Boothbay Harbor, Maine. Joe says he decided his five grandchildren were too young to carry on his Boston business, one of them being a freshman at Wellesley College, and the others still in prep school, so he decided to retire. Says Joe, "if any classmates are in this area, we would like them to visit us. Our apartment is on the ocean front and you can look east and 'see Europe on a clear day.' " Good old Joe!

Art Merriman answers my expressed wonderment at how he happened to send me a birthday card. He says, "It's easy, just look in the *Technique* for 1920 (dated 1921) and find not only your own youthful-looking picture but the birth date of each graduate." Art writes that he talked with **Carleton Alexander** by phone and that Carleton and his wife are well and happy and proud of the fact that one of their nephews is President of Dartmouth College. The Alexanders keep active, do a lot of walking when weather permits, and Carleton operates a power mower to keep ahead of a large area of lawn. Art also talked with Chuck Reed and was told about the big celebration of their Golden Wedding Anniversary. Art sends "best wishes to all the Class for 1973 and for the future." His address is 2314 Lamberton Rd., Cleveland Heights.

At a joint meeting of the New England and New York Society of Fire Protection Engineers, in West Haven, Conn., **Perk Bugbee** gave a talk on the National Commission on Fire Prevention and Control's study and investigation to determine effective measures for reducing the destructive effects of fire throughout the U.S. Perk was appointed to the Commission by President Nixon at the time it was formed in 1970.

A report from those redoubtable blue water sailors and navigators, **Henry Haskell** and **Hank Caldwell** indicates that they are still enjoying life on the briny deep. Henry admits that he is "ungainfully employed" but goes on to say that he continues as Chairman of Brunswick Worsted Mills and Carvill Industries. . . . **Clarke Morse** proudly reports his *second* great grandson, Matthew Garrett Pizzedaz.

In a brief report last month of the death of our beloved classmate, **Al Glassett**, I promised further information. Al had been with the W. J. Barney Corp., of New York since 1924 and elected its president in 1951. He served the Institute well, as President of the Alumni Association, President of the M.I.T. Club of New York, and Chairman of the Alumni Fund Board. He was a life member of the American Society of Civil Engineers and Director of its metropolitan section, a member of the New York State Society of Professional Engineers, President of the Scarsdale Golf Club, and Vice President of the Union League Club of New York. His well-earned retirement to Pompano Beach lasted only a year. He will be sorely missed by us all.—**Harold Bugbee**, Secretary, 21 Everell Rd., Winchester, Mass. 01890

21

At the time of writing, it is the day of the Super Bowl game—Miami Dolphins vs. the Washington Redskins. The question of a Florida Interim Reunion in March has been settled in favor of an informal get-together for a day or two at St. Petersburg and the Bardmoor Country Club. Those living in Florida and others who have written their intention of visiting Florida this winter will be contacted. The affair will be taking place about the time you receive this copy of *Technology Review*.

Two good letters from Assistant Secretary **Josh Crosby** told of a delightful luncheon date in December that he and Claudia had with Pat and **Allen Addicks**, and Graciela and **Helier Rodriguez**. During the afternoon they visited with Muriel and **Victor Phaneuf** who live in a condominium at Bardmoor. Vic, who retired from his professorship at the University of Florida, is still doing consulting work. Josh reported playing bridge with Millie and **Herbert Kaufmann** (without the score) and a visit by phone with **Larcom Randall**. The Randalls spent last summer at their cottage on Lake Winnipesaukee.

Assistant Secretary **Sam Lunden** sent along a welcome note from Captain **Alfred Balsley** of Pebble Beach, Calif., who reported active naval duty until his retirement in 1946. He served on submarines, destroyers, cruisers, and battleships, and his sea duty took him to most of the important posts around the world. Living with his family at Pebble Beach, with many other service friends nearby, has made his retirement most enjoyable. . . . Class President **Irving Jakobson** had lunch with **Henry Du Pont Baldwin** just before Christmas at the New York Yacht Club. Baldy is troubled with emphysema and was having treatments in New York to try to relieve his breathing difficulties. Here's hoping, he got some relief.

O. Kenneth Bates of Canton, N.Y., was honored last November by having the Mathematics Section and Facilities at St. Lawrence University named in his honor. Congratulations! Ken retired in June 1967 as Cummings Professor Emeritus of Mathematics. After graduation, Ken taught for 12 years at M.I.T., followed by 34 years at St. Lawrence University in Canton. Quoting Ken, "A most interesting and exciting life."

L. Willis Bugbee, Jr., of Detroit, Mich., returned recently from his fifth trip to the Orient in the last five years. This time he "flew out to Rangoon via Hong Kong and visited Burma, Thailand, Malaysia, Sumatra, Java, and Bali." His return took only two days, flying from Bali to Detroit via Australia and Fiji. He has now resumed his patent law practice in Detroit.

A newsy letter from **Albert S. Genaske** of Fryeburg, Maine, received at New Years, told of his trips during the last year and plans to spend two months this winter at Port St. Lucie, Fla. Last March, Al and Theona took a four and half day shanty-boat cruise from Ft. Myers, Fla., up the Caloosahatchee River to Lake Okeechobee and return. An entertaining saga about the cruise was prepared by the Genaskes and sent along to your Secretary. In this saga, Al describes the houseboat *Lazy Bones* with its eight staterooms, mess hall, and galley. "Each mini-stateroom had upper and lower bunks and woe be to him who sat up suddenly in bed and bumped his head. Two of us could not dress simultaneously so I was evicted each morning. Measured the deck circuit in my need for exercise after wonderful meals and found I could jaunt a mile in 44 laps. Myriads of aquatic birds, enormous speed of five knots." Al invites those who are around Fryeburg in the summer to phone Farrington's Camps, Theona's summer hotel on Kezar Lake, and he'll put on a slide show of the cruise.

With sadness we report the death of three of our classmates, **Victor O. Homerburg** of Santa Barbara, Calif., **Edward W. Noyes** of Nokomis, Fla., and **Theodore A. McArn** of Cheraw, S.C. Professor Homerburg served on the faculty at M.I.T. from 1917 to 1950, and as a consulting metallurgist worked on the development of the atom bomb. We are indebted to Cac Clarke and Richard Feingold, '43, for supplying an obituary on Professor Homerburg. Ed Noyes became a Florida resident about a year ago but continued to spend his summers in Pennsylvania. The sympathy of the Class is extended to their families.

One of the real joys of Christmas is the flood of Christmas cards. Your Secretary sends grateful thanks to all of you and especially those who included some news which may be shared with the Class. . . . **Ed Delany** writes that he and Kay have moved to Florida "for good, and we love it here. **Mich Bawden** dropped in to say hello and we expect to see many other classmates." Their new address is : Executive Club—Apt. 209, 3300 Gulf Shore Blvd.-N., Naples, Fla. 33940. . . . Betty

and **Dugald Jackson, Jr.** sent a Christmas greeting in verse which included their travel resumé for the year "only to Florida and Maine." . . . Ruth and **Ted Spitz** were planning to spend February in Venice, Fla. . . . Dorothy and **Joe Wenick** reported that their son Martin was getting a January vacation leave to visit home from his assignment as Second Secretary at the American embassy in Moscow. . . . Ceil and **Frank Huggins**' delightful Christmas letter, illustrated by Frank, told of the last year's activities at their plantation farmhouse in Frogmore, S.C. The Haywards saw it two years ago when it was about half rebuilt. Ceil says that instead of "a hopeless situation even a dog wouldn't care for, people now call it a showplace." A year ago the Huggins thought they were about to be mobbed when they suddenly saw a crowd of about 50 black people and a weird looking white man back in the field adjacent to their farm. A hurried phone call disclosed that a documentary film about the Reconstruction Period was being made! . . . Helen and **Bob Miller**'s wonderful Christmas card with individual photographs of their children's families is a welcome addition to the class files. The Millers stopped to visit Graciela and **Helier Rodriguez** in Tampa just before leaving on a December cruise in the Caribbean. "A wonderful cruise," says Bob. . . . A nice note from Helen St. Laurent told of hearing from the Clarkes and the Jakobsons. She was considering attending the 25th Fiesta in Mexico in March. . . . Betty Patton's Christmas letter told of the tragic devastation in northeastern Pennsylvania caused by Hurricane Agnes. Fortunately, the Patton home is 500 feet above the valley but her office had ten feet of water and mud left behind. Betty is planning a few days in Florida this winter and a windjammer cruise off the Maine coast this summer. . . . Christmas family letters from Maida and **Ed Dubé** and from Emma and **Leon Lloyd** tell of the busy days of 1972 with their friends and families. Healthwise, Maida and Ed both watch their steps but say "Hurrah for modern medicine." A highlight of the Lloyds' year was when their children and eight grandchildren were all together at one time in Westerly, so that beds, cribs, and sleeping bags were needed to bed them down.

Elizabeth and **John Barriger** wrote that in early January they were vacating their little "broom closet" apartment on Tremont St. in Boston and returning to their home at 15 Washington Terrace, St. Louis, Mo. 63112. . . . Lucille and **Alex Lapointe** of Birmingham, Mich., report good health and the continuation of Alex in the consulting business for the automotive industry in new products and pollution control. . . . Madeline and **Rufe Shaw** had plans for a trip to Australia in January. Rufe writes that he "made his daughter an electrician and she loves it." Women's Lib?—**Sumner Hayward**, Secretary, 224 Richards Rd., Ridgewood, N.Y. 07450; **Josiah D. Crosby**, Assistant Secretary for Florida, 3310 Sheffield Cir., Sarasota, Fla., 33580; **Samuel E. Lunden**, Assistant Secretary for California, Lunden and Johnson, 453 South Spring St., Los Angeles, Calif. 90013

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Your Secretary is still complaining in January about the lack of snow and the especially poor business for ski resorts 20 miles south of Buffalo. It doesn't seem right to leave this beautifully clear winter climate to go to Florida and the Caribbean—but off we go, ready or not, on the *Nordic Prince* out of Miami. Our mails have not been marked by a plethora of news but we did receive the M.I.T. 1972 Presidential Citation for the Class of 1922 in grateful recognition of distinguished service to the M.I.T. Alumni Association. We hope that you all received a similar award.

William H. Mueser of Mueser, Rutledge, Wentworth and Johnston, consulting engineers of New York, has announced an enlarged partnership and an addition to the staff of Senior Associates and Designated Associates. Bill has been an outstanding and internationally known engineer for many years and has performed important consultant and design work for the foundations of buildings at M.I.T. . . . **Lloyd A. Elmer** visited friends in Wellesley Hills over the Thanksgiving weekend. They drove around the M.I.T. campus, which, he says, seemed more impressive than in 1922 and really mirrors the dedicated men who work there. . . . Since retiring as Secretary-Treasurer of Decorated Metal Manufacturing Co., **Charles M. Welling** has traveled twice to Japan, Hong Kong, England, and Scandanavia. He visited Switzerland and also saw the Passion Play at Oberammergau. He spends his summers in Vermont. . . . **G. Dewey Godard** of Marblehead retired from the General Electric Co., in Boston. He wrote that he was sorry to miss our 50th but sent an extra check to the Fund to make up for his absence.

Samuel I. Zack spends the winter months at Miami Beach, enjoying the sun and recreation. He is partially retired as Senior Vice President and Vice Chairman of the Board of Gannett, Fleming, Corddry and Carpenter, Inc. His activities encompass management and company policy. . . . **Broderick Haskell** has retired from Bache and Co., but continues his activities with the Council of Foreign Relations, as trustee of the Cathedral of St. John the Divine, and as vestryman of St. Thomas Episcopal Church. His free time is filled by travel, ranching, and fishing. . . . **Thomas M. Taylor** tells us he is doing well. Now and then he sees old friends from M.I.T. which adds to his well-being. . . . **F. Willett Walton, Jr.**, (Luke), sent greetings accompanied by some outstanding art work. It seems we have a Rembrandt in our Class of '22.

The sympathy of the Class is extended to the family of **Richard Smith Chatfield** of Summerville, N.J., who passed away in December 1972. He was a retired structural engineer with the Equitable Life Assurance Co., a veteran of World War II, and a member and secretary of the original planning board of Branchburg, N.J. He is survived by his wife, Ruby Freer Chatfield, and three sisters.

We were delighted to receive greetings from Catherine and **Mac McCurdy** showing their many-tiered 50th Anniversary cake topped by a small bride and groom. But more important was the lovely photograph of Kate cutting the cake. She was wearing a golden gown, a corsage, and a sparkling smile from those Irish eyes—while Mac proudly looked on with obvious delight. We hope that many members of the Class will have the opportunity to enjoy a similar thrill at their 50th.

Among the changes of address received were: E. Irving Bell, Ft. Lauderdale, Fla.; Paul J. Choquette, Narragansett, R.I.; Lamonte Griswold, Sudbury, Mass.; Reginald S. Hall, Hendersonville, N.C.; Dr. Samuel H. Manian, North Attleboro, Mass. . . . While so many of you are enjoying the sun, golfing, and the pleasures associated with winter homes, items of interest are scarce indeed! So we conclude our notes with a tearful and earnest plea to send in news about yourselves and we hope it's real good!—**Whitworth Ferguson**, Secretary, 333 Ellicott St., Buffalo, N.Y. 14203; **Oscar Horovitz**, Assistant Secretary, 3001 South Course Dr., Apt. 103, Pompano Beach, Fla. 33060

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Miscellaneous notes received this month include: **John E. Burchard** who says "Sorry we will miss the 50th Reunion as Mrs. Burchard and I will be in the Swiss Engadine Alps at that time." We will miss you John, why not postpone that trip? . . . Colonel **Robert Sears** writes "I took a post-graduate course in 1923 with a group of Ordnance Officers of the U.S. Army. I can't see that this makes me a member of the Class of 1923." You are indeed a member of our Class, Colonel, according to our files and the Alumni Register—hope to see you at the 50th Reunion! . . . **Bertram E. Warren** tells us "In September, at Kyoto, Japan, I finished six years as Vice President of the International Union of Crystallography." . . . **William Wolfe** relates that he is "completely engaged in enjoying a glorious retirement—bridge, chess, the gym and the pool."

James A. (Pete) Pennypacker continues to be most active in his retirement. (?) He has recently published a novel, written by his uncle, Isaac Rusling Pennypacker, entitled *The Redemptioner,* concerning a young Englishman who, just before the American Revolution, was obliged to indenture himself to a Pennsylvania farmer. We hear that it makes excellent reading. It is published by the Pequot Press. The manuscript was found by Pete's cousin who sent it to Pete to be polished prior to publication.

We have, unfortunately, several deaths to convey this month. In December, **Charles T. Grant** of Melrose, Mass., and Meriden, Conn., passed away. After graduating with our Class, Charles joined the Metropolitan Life Insurance Co. In 1952 he became District Manager of that company in Rochester, N.Y., and in 1957 moved to Meriden to become District Manager there, retiring in 1967. At the time of his retirement he was a Chartered Life Underwriter.

In our February issue we mentioned the death of **Stanwood E. Whitcombe** in November last. A resident of Scituate,

Mass., he was owner of the William H. Mitchell and Son heating firm from which he retired in the mid-1960s. After that time he became a project engineer for the State of Massachusetts with offices at Government Center in Boston.

We have also learned of the passing of **William F. Barrett** of Lowell, Mass., on December 6, 1972; **Lewis L. Harr** of Murrells Inlet, S.C., on May 11, 1972; and **Robert W. Hughes** of Syracuse, N.Y., on November 7, 1972.

Please act on the mailing of reunion notices as requested by us in order to secure accommodations at the Marriott! —**Thomas E. Rounds**, Secretary-Treasurer, 4 Deer Hill Dr., Danbury, Ct. 06810

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It is January 16, and your scribe has just received an urger from the *Review* Alumni News Editor to meet the deadline. Weary as he is from physical problems and legal shenanigans of selling his house and going condominium, he has extremely sound advice to everyone who is over 64. "Get into one-floor living quarters and no do-it-yourself maintenance while you are still Mr. Strongman!" While writing this from the fifth floor, I look out on the Boston skyline and say, "Let it snow, let it snow." I regret that this month, my notes must consist of what was received from the Alumni office. Ethel and I still have 15 barrels and cartons to unpack and among them are my records used as background.

The Alumni office has been notified of the death of **William C. Bartow** on June 30, 1972. His last known address was in Belmont, Mass. We regret that Bill has dropped from our ranks.

Edward S. Taylor is this month's prize winner. Ed lives in Lincoln, Mass., and in 1968 became Professor Emeritus of Flight Propulsion in the M.I.T. Department of Aeronautics and Astronautics. He has been selected to receive the $10,000 Robert H. Goddard Award of the American Institute of Aeronautics and Astronautics. In 1946, Ed established M.I.T.'s Gas Turbine Laboratory following the outgrowth of the jet engine in World War II. He will be honored "for continuous and successful contributions to the advancement of the art and science of air-breathing propulsion over a period of 45 years as designer, inventor, and as founder and leader of a major educational and research center of aircraft engine activity." . . . **Marshall Waterman** writes, "Last May, Mrs. Waterman and I had a most enjoyable trip, by ourselves, to Italy, Switzerland and home via Amsterdam and London. We will be right here in New Jersey this winter except about a month driving to Florida and Mississippi to see friends."

Tien A. Koe tells us, "About two months ago, we left Harrisburg, Pa., and came out here to Honolulu intending to be permanent residents in this Aloha state. It is a great place to retire to. During the period we are here, we have not had a single bad day." . . . **Ed Moll**, our hard-working class president, but a man of few words, notes: "That **Frank Shaw** should be congratulated on his work. They certainly grind exceedingly fine." . . . **C. M. Chaffee** keeps us somewhat in the dark, although his return address is Washington, D.C.—"As purchasing for above concern. Still going strong (thanks to God's will) at age of 73." . . . **William C. Ross** was in Naples, Fla., for the month of February.

M. T. Crowell has been in the insurance business (company and agency) all his life 'since 1927'. Probably will retire completely in next two years and has been partially retired since December 1962. He has a wife, Lydia and three children (one son an M.I.T. graduate). He is a member of the Milwaukee M.I.T. Club, active at Tripoli Golf Club and likes to travel. . . . **John H. Walthall**'s envelope from Sheffield, Ala., encloses a Christmas letter and he says that maybe your Secretary can extract something from the full page. I am not a centrifuge, but it appears that Jack and Eva spend half the year on their boat. They may be emulating Ponce de Leon, chugging in and out of every arm of water from Urbanna, Va., finally berthing *Eden II* near Myrtle Beach last October. In January, they headed South down the Waterway probing Savannah and the St. John's River. They saw beautiful rivers and creeks, places and houses of historic interest everywhere. Their enthusiasm sounds as if they had found the Fountain of Youth, but not telling where.

One of the rewards of the Class Secretary's office is the many personal greetings at Christmas, and they are much appreciated. For instance, **Nish Cornish** and Luisa urge us to come to the 25th Annual Mexico City Fiesta and at the same time mention a family increase to 13 in April. I assume that he is speaking of grandchildren. Although Ethel and I expect to be in Tucson in March, the Fiesta is uncertain. **Clint Conway**, **Paul Miller**, **Gordon Harvey** invited us to Florida.—**Russell W. Ambach**, Secretary, 216 St. Paul St., Brookline, Mass. 02146 (Note new address).

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An article in the *Cambridge Chronicle*, our local weekly, featured the name of **F. Leroy Foster** who is better known to most of us as "Doc." The item announced his retirement as Director of the Lowell Institute School on June 30, 1973. Doc has held this position since 1959 in addition to being a member of the M.I.T. staff. The Lowell Institute, meeting at M.I.T., provides, for a modest tuition fee, evening instruction in technical subjects for men and women working in industry. Many of the teaching staff are drawn from M.I.T. Of chief interest to us of '25 is that on his retirement Doc will no longer be based at M.I.T. and we will not be able to drop into the familiar office on the first floor. Doc, however, will be at home on the Cape and his address is Woodland Way, P.O. Box 331, North Chatham, Mass. 02650, Telephone 945-2236. Doc informs me that he has a new *Welcome* mat to be placed at the door and all are urged to contact him when visiting Cape Cod.

Roger Ward was in the Orient from May to August. In Hong Kong he had dinner with **Peter Sin** who intends to be with us for the 50th. . . . **Yu H. Ku** received the Honorary Doctor of Laws degree from the University of Pennsylvania in May, 1972, where he is now Professor Emeritus. He was also awarded the Gold Medal of the Chinese Institute of Electrical Engineers last year. . . . **Gilbert W. Noble**, in retirement, is enjoying stamp collecting and with Mrs. Noble breeds and races harness horses. He also is looking forward to 1975. . . . **Milt Salzman** writes about the same as last time—semi-retired, occasional consulting work, but mainly occupied with amusing grandchildren, traveling, and barbershop-quartet singing.

I am sorry to have to record the passing of Dr. **William L. Gilliland** of Lafayette, Ind., on May 6, 1971 and **Edward A. Hagstrom** of Gloucester, Mass., on September 19, 1972.—**E. Willard Gardiner (Will)**, Secretary, 53 Foster St., Cambridge, Mass. 02138

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All the nice Holiday notes received from Classmates in the warm climates made us envious in the mid-January deep-freeze at Pigeon Cove. However, almost snowless, we emerged a week later into shirtsleeve weather (mid 60's) but not complaining. This Sunday morning, the temperature is back to winter normal but the sea is gorgeous, white caps offshore because the wind is northwest, and clear enough to expose a merchant ship on the horizon.

One of the notes from Classmates was from **Eben Haskell.** "Dear George, the enclosed October *Electrical World* carried a picture and a reference to our good old illustrious classmate, **Sid Brookes.** My wife and I have reservations for the 25th Anniversary Celebration of the M.I.T. Club of Mexico City in March. I hope I'll see some others from the Class of '26." Eben's address is 215 Hartford Tpk., Hamden, Conn. 06517.

A note from **Bob Richardson** tells of seeking Isabel and **Ray Mancha** in Winter Park, Fla., last winter. From the address change list we note that **Ted Larratt** now has a Winter Park address—wonder if the two classmates are aware of each other. We read between the lines that Ted shifts his address from Maine to Florida with the seasons and **Harvey Abbott** appears to do the same. . . . One who likes it where he is, **"Deke" Nason**, has written from Riverside, Ill. "At this season of the year we all try to keep open the lines of communication with 'old' friends. I have just learned that classmate **Roderick L. Jerrett** died in July, 1971, of cancer. His widow, Martha, and son Rod still reside at 1130 W. 14-mile Rd., Birmingham, Mich.

"For myself, it has been three years since retirement and health remains good. We have toured the country several times but found no place more attractive to us. So, we have stayed put here. I missed the 45th Reunion but have high hopes of being around for the 50th in '76. Hope you can keep the pot boiling

'til then." . . . Miriam and **Elton Staples** have taken up to following the birds south (from Cape Cod) and write "Come on down. It's 22 degrees C. right now, warm sunshine overhead, and the blue waters of Lake Conway off the lawn. Come for a sail!" Now that last statement does rouse me—how I would love to go sailing right now! . . . **Al Entwistle** is still going strong in his Howard Johnson Restaurant and Motel business in Louisville, Ky., and sends his greetings to the Class. . . . Out in Portland Ore., **Pete Bellaschi** writes that he has just celebrated the 25th anniversary of his world-wide consulting service to the electric power industry and he is still going strong. . . . **Dave Harrison** has gone into the publishing business with a new edition every December. His latest 1972 issue, in addition to the story of his travels to and with his large family, contains twelve photographs and a family directory. I'm sure the 1973 edition is beyond the planning stage by now at Grove City, Pa.

It's such a beautiful winter day, we must fulfill our promise to our collie "Heather" to let her take us walking—to the Post Office with these notes—so Cheerio until Spring.—**George Warren Smith**, Secretary, P.O. Box 506, Pigeon Cove, Mass. 01966

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Dick Hawkins writes from aboard the M.V. *Oriental Carnaval* that he and Mary sailed from Los Angeles on December 27 on a four-month 'round-the-world cruise. First stop, Acapulco, then through the Panama Canal. This is the same cruise that Ann and **Joe Harris** were booked for, as reported in the February notes; the Harrises were scheduled to come aboard at Port Everglades. The ship is a 22,000-ton cargo-passenger liner, with 230 passengers. Both Joe and Dick have promised to send some reports of the cruise, including the planned "1927 mini-reunion" with **Wally Kwauk** in Hong Kong.

A clipping from the *San Diego Union,* more than a year old now, which has just reached me, reports at length on the successful growth of Spectral Dynamics Corp., and its Chairman-General Manager, **B. Allison (Bud) Gillies.** Bud had been a partner in a management consultant firm for some years and in various executive positions in the aircraft industry, when he joined the group which formed Spectral Dynamics in 1961. The company started by buying a group of patents developed by General Dynamics for the Convair 880-890 test program. It subsequently built on that base a broad line of sophisticated test instruments, used primarily in acoustical research, but also in medicine and other fields. Through the period covered by the article, it had been bucking the general downtrend in business and profits of science-based companies.

Your Secretary, after a year at City Hall, was appointed City Treasurer and Assistant Director of Finance of New Rochelle, N.Y., effective January 1, 1973. I started working for New Rochelle—which adjoins Scarsdale—four months after retiring from Standard Brands. My only previous experience as a bureaucrat was with the W.P.B. during the war, and that was quite a different kid of bureaucracy (production scheduling, materials allocation, etc.) This job involves areas which were all new to me—tax and revenue collections, investing and borrowing, and maintaining the financial records for a city of 75,000 population and a General Fund budget of $21,000,000. I am thoroughly enjoying it.

Jottings: **Bill Felch** is keeping active with ham radio and Civil Defense; he is still in the suburban New York area. . . . **Art Buckley** works part-time as a substitute teacher in the Washington County, Md., high schools, chiefly teaching Math and Science.

It is with a sense of profound shock that I report that **Bob Bonnar**—First Vice President, Treasurer and Reunion Chairman—died suddenly on February 13. The details will have to wait for the next issue.—**Joseph H. Melhado,** Secretary, 24 Rodney Rd., Scarsdale, N.Y. 10583

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By the time you read these notes, our Class Reunion will be only a few weeks away. If you have not yet sent in your reservation, we urge that you do so. This is going to be a wonderful week-end party at the fabulous Bald Peak Colony Club on Lake Winnipesaukee in beautiful New Hampshire. *Don't miss it!* Your Reunion Committee has been working hard to make this, the 45th, a memorable occasion.

In late December, **Florence Jope**, with daughters Roxanne and Deborah, flew to England to attend the wedding of son Ted and Sarah Virgo-Williams. Frannie and **Jim Donovan** were also there. The newlyweds will live in the United States. Ted, having completed his navy service, plans to enter graduate school to study business administration. Florence remained in England for two weeks and enjoyed visiting with friends and various places of interest. The Donovans remained only a few days, then returned to meet obligations at home.

So many holiday greeting cards were received by your Class Officers collectively that it would be impractical to list them here. Every one of them was most welcome and fully appreciated. Some contained news notes that we are happy to relay to you: From Olive and **Newton Foster**: "Immediately after Labor Day we flew to England, staying in London a few days, then going to the Sixth International Congress of Iranian Art and Archeology in Oxford and London for nine days. We were among 300 participants from 30 countries, and the experience was most interesting. After another respite in London, we flew to Athens and joined the Magic Carpet Tour sponsored by the Textile Museum of Washington for 20 days in Turkey and Greece, with Turkish rugs as the main focal point. The 19 of us had a harmonious, delightful, and informative time. What we appreciated then was a week of rest and relaxation in beautiful Athens before flying home. " . . . Lillian and **Tom Larson** expect to be in Florida until mid-April and then will travel back to Orleans on Cape Cod. . . . Clara and **Arch Archibald** have become interested in stone carvings of the Canadian Eskimos. One of the pieces they have acquired is a polar bear cub in white quartzite by the artist Pudlo who also did the stone block print of the musk ox on the U.N.I.C.E.F. cards they sent out. . . . Gladys and **Bill Phillips** have moved to Albany as a result of Bill's office having been transferred to that city.

Anne and **Will Tibbets** are planning to do some winter camping at their "deep freeze" in New Hampshire, not far from Bald Peak. . . . Pam and **René Simard** wrote that they are finally fully retired and enjoying it. They intend to be at the 45th. . . . Bonnie and **Vern Lewis** apologize for being poor correspondents but hope to do better after Vern retires in August. . . . Last spring, Betty and **Dud Smith** took a 25-day tour of the Central American Countries. They were amazed by the Mayan ruins at Uxmal and Chichen Itza in Yucatan, at Tikal in Guatemala, and Copan in Honduras. They found the scenery beautiful and travel accommodations delightful everywhere they went but liked Guatemala best. . . . In her Christmas letter, **Virginia Rigby** described her 1972 travels which included a conference tour (Pan Pacific and Southeast Asia Women's Association) to New Zealand and Australia with stops at the Fiji Islands on the way down and at Samoa and Tahiti on the return trip. In the fall, she took a boat trip from Rhode Island up the Hudson River to Oswego via the canals, then across Lake Ontario to the Thousand Islands and Kingston, Ont. The latter trip she found "a unique experience with delightful people." . . . **Slim Maeser** enjoys lots of golfing when the weather is good but still does some consulting work with United Shoe Machinery Corp.

A note from Ann and **Bill Woods** announces that Bill has been ordained a permanent deacon in the Roman Catholic Church. This is a recently re-established office of the church for which Bill has been working and training since his retirement. He finds the many duties very rewarding. . . . Verna and **Rudy Slayter** have much enjoyment in their two grandchildren, four-year-old Elspeth and two-year-old Abigail, an adopted Korean girl. . . . A long news letter from Louise and **Ernie Knight** tells of their 6½-week cruise aboard the freighter *Export Ambassador* to Mediterranean ports. We can do proper justice to this excellent letter at our next writing. . . . Writing from Tokyo, Japan, **Shikao Ikehara** deplores the creeping inflation now overshadowing the people of his country. He does not complain, however, so long as his health remains good. He is now teaching at three colleges.

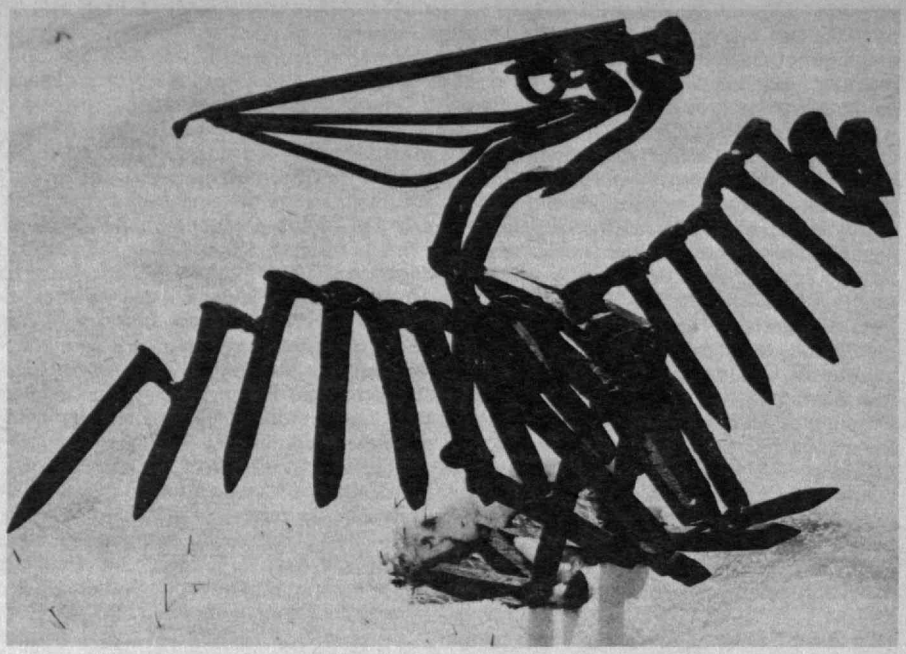
Charlie Worthen, our patient and hard-working Class Agent, was pleased to receive a note from **Bud Gray** along with a generous donation to the Alumni Fund. Bud has not been able to make it to Class Reunions because of schedules that have taken him to various parts of the world. Now as a member of the Executive Committee of the M.I.T. Cor-

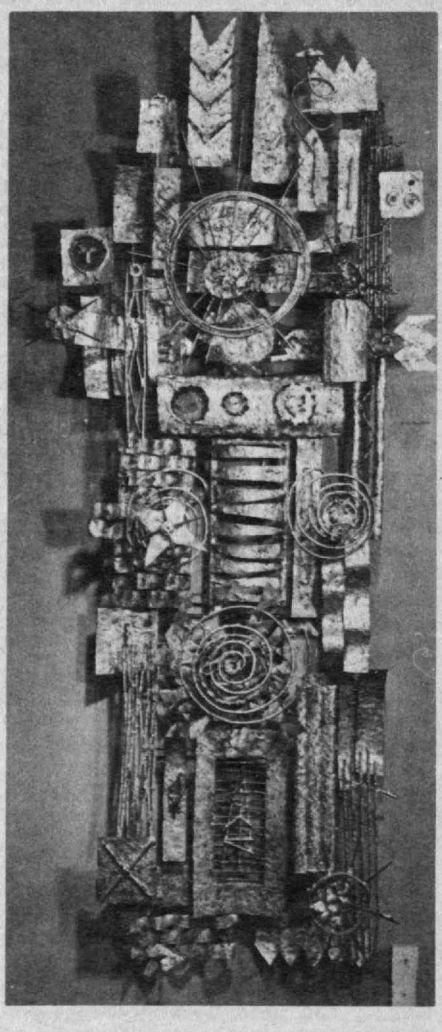
C. F. Taylor: Having Fun With Bird and Beast in Steel

When C. Fayette Taylor, '29, retired as Professor of Automotive Engineering in 1965, he simply found more time to turn what had been an avocation into a vocation. Even before then his metallic abstractions of birds, animals, and "things" had won for Professor Taylor widening fame as a sculptor; since retiring he has had one-man shows in four states and has works in collections and exhibits throughout the east.

Reviewing his most recent one-man show in the Thomas Crane Public Library in Quincy, Diane Baltozer wrote in the *Quincy Patriot Ledger* that Professor Taylor's "engineering background merges with his artistic, nature-oriented temperament" to create metal sculptures which are almost caricatures of natural and man-made forms.

Three Taylor sculptures adorn M.I.T.—an untitled stainless steel form in the Faculty Club bar, an untitled brass wall sculpture in the headquarters of the Chemistry Department, and an assembly of water wheels (titled "Hydraulic Experiment") in the Parsons Laboratory. The Denver Art Museum has recently bought "Spirasphere," a six-foot structure of flexible stainless steel spirals, for its garden. "Upward Bound," a hanging sculpture of brass tubing, is in the Charles F. Hurley Building plaza in Government Center, Boston.





"My greatest joy is in building a variety of objects," says C. Fayette Taylor, '29, a retired M.I.T. aircraft and automotive engines expert turned full-time sculptor. Two of these works—"Ikon," a 70-in. brass on copper abstraction, and "Pelican" from the collection of Mr. and Mrs. Charles Letson of Naples, Fla., were part of a one-man show in the Crane Public Library in Quincy this winter; "Goat," opposite, is on display in the Boston Savings and Trust Co.

poration he makes a quick visit to Boston each month. He finds his association with the committee very stimulating. . . . Our classmate and very generous citizen, **Carney Goldberg** was recently elected Chairman of the Board of Registration of Architects in the Commonwealth of Massachusetts. Carney has worked in this field for years and has given much to the people of the state. . . . **Bill Murphy** was thoughtful in sending to us a copy of the editorial page of *Aviation and Space Technology* for December 18, 1972. Listed there are 21 names of men and women whose contributions to aerospace in 1972 were considered most meritorious. Leading the list was: "**John Stack**, long-time N.A.C.A. and N.A.S.A. aeronautical researcher and Vice President-engineering of Fairchild Industries, Inc., for a lifetime of outstanding contributions to basic advances in the aeronautical state of the art that ended with his death in a horseback accident last summer."

A news release from Hearst Magazines announces that **Albert S. Dempewolff**, Vice President in charge of the Motor Division, will retire later this year. He has been with Hearst since 1960 when he began as Good Housekeeping's Director of Marketing. Writing separately, Dempe says he hopes to have things settled by May so that he and Martha can be at the Reunion. . . . A batch of news panels from the Alumni Fund Office gives us the following: **Howard Emerson** writes "I retired as Professor of Industrial Engineering at the University of Tennessee on September 1, 1972. Fannie and I still live at 4237 Holloway Dr., Knoxville, Tenn." . . . **Roger Haven** says: "I presented a talk on 'The Sport of Ice-Boating' to the Fryeburg-Lovell Kiwanis Club." . . . From **Henry LaCroix**: "I retired from Foster Wheeler at the end of October, 1971 after 34 years. Much of my last 13 years was spent in foreign service—five years in Japan and the balance in Europe, Kuwait, and Algeria. We moved to our present address last spring. I would do some consulting work but there is not much in this immediate area. We will try to be at the Reunion." **Nathaniel White** reports briefly: "Retired in 1969 after 33 years with the War Department (Signal Corps)."

We have from **Karl Otte**: "In September, 1971 I retired from teaching at the Chicago Circle Campus of the University of Illinois. This was my second retirement since I had already been retired by American Bakeries Co. This time the calendar says my retirement is permanent." . . . From **Dean Batchelder**: "Ellen and I now spend most of our time at our mountain foothill grazing ranch on Tyler Creek two miles below California Hot Springs (water at 120°F). This old-time resort has not been rebuilt since it burned down about four years ago. We have a good climate at 2800 feet elevation and see most of our snow east at 6000 to 8300 feet (Mt. Tobias). Johnsdale and Kern River are about 22 miles east on a dirt road over the mountains. Sequoia National Forest is east of the ranch and in some years 50 to 100 deer will winter on the ranch. This year there were several bears as well."

We are very sorry to report at this time the deaths of two classmates. **Joseph A. Jamison** died July 22, 1972. Joe graduated in Course X-B and made his career with Mobil Oil Co. (formerly Socony-Vacuum). Just after World War II, Joe spent ten years rebuilding refineries in the various countries of Europe. His last three years were in retirement. Our sympathy goes to his wife Dorothy.

William C. Hutchinson died November 16, 1972. "Hutch," as he was known to friends, was an engineer in the Mechanical Design Division of Stone and Webster Engineering Corp. He retired January 1, 1970 after serving his company for more than 25 years. We talked with his wife, Mildred, and extended to her the sympathy of the Class.—**Walter J. Smith**, Secretary, 209 Waverly St., Arlington, Mass. 02174

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Nicolaus L. Harms writes, "I am retiring on December 1, 1972 after 42 years of continuous service with my company (Symington International Co., Ltd.,) in the course of which, I had the opportunity to travel extensively and visit virtually all countries in the free world. I have sold my house in Scarsdale, N.Y., and purchased a condominium at 2121 N. Ocean Blvd., (A-1-A) Boca Raton, Fla., 33432, where my wife and I hope to settle sometime before January 1; and see more of our son and daughter-in-law as well as our two little grandsons than time and distance have permitted us to do in the past. My future plans also include a little teaching at the local University, consulting work in foreign trade, and a great deal of golf and deep-sea fishing interspersed with travel, which my wife and I both enjoy."

William F. Jenkins has retired after 42 years of service with the Houston Lighting and Power Co. He is now building a new 20-acre arboretum, in which he plans to have 200 kinds of trees—his present two-acre one has only 120 varieties. His chief interest is planting trees and seeing them grow. . . . A "thank you" note comes from **Harold A. C. Dahl** Westford, N.Y., who is living an active and busy life of retirement, being involved in community affairs both at the county and local level. He is also active in his church, Coast Guard Auxiliary Masonic affairs, and Shriners.

Macon Fry writes, "Thank you for the birthday greetings. I retired from the Operations Research Office of the Johns Hopkins University some years ago. Since then, I have done an occasional consulting job and written a few papers. One, on crime waves, I presented at the Fourth International Conference on Operational Research at M.I.T. I was also associated with the late Melvin M. Johnson, the gun designer, until his untimely death a few years ago. I am a member of Operational Research Societies in Great Britain and Japan, the American Ordnance Association, a senior member of the I.E.E.E., and a life member of the National Rifle Association."

A birthday greeting to **Vinton L. Yeaton**, Hampton Falls, N.H., brought a sad note from his widow. "My husband never saw the birthday greetings from the Class of '29 as he passed away on December 13, 1972; two days before his birthday, after 12 years of suffering with emphysema and rheumatic heart disease. We used to hire a cottage on the sea shore at Hampton, where you live, where we spent many happy summers. Thank you for your thoughtfulness."

Oscar Aros Villa, Mexico City, writes, "My wife, Soledad Ponton Fernandez de Cordoba, my daughter Carolina, and I have just moved to Spain to live. We came to join our eldest daughter, Irra, and her family who are living here in Algorta, Vizcoya. We left our two sons, both married, and a grandchild in Mexico City. I have nothing to do but live peacefully here in Spain. I plan to meet as many fellow Alumni as possible and study the prospect of starting an M.I.T. Club of Spain. I will keep you informed. Regards and best wishes to all the classmates."

Donald L. Hibbard writes, "Upon retirement at the end of 1972, my wife Kay and I decided to leave Philadelphia and move to Colorado, just north of Denver. We like the 5000 feet altitude and hope the air stays clean and brisk. It will be a new lifestyle, a complete change for us. For years I've been advising people about retirement and now, I am following my own advice. If any of you '29ers get to the Denver area, we would be glad to have you stop and see us."

Malcolm M. Hubbard, Newton, Ma. is still very active in his Consulting Engineering field. He has picked up two new clients and hopes 1973 will be a better year than either 1972 or 1971. He and his wife, Elizabeth, are in best of health, though Elizabeth had pneumonia last summer, "but," he says, "like the old joke, they knew what to do for that. She recovered promptly." The Hubbards are planning a trip to Bermuda in the early part of January.

Ruth Davies Van Wagenen writes, "Thank you for my birthday card from the Class of 1929. The first I have received in the 43 years since I graduated. My husband passed away in September, 1971. In the summer of 1972, I sold my house in Skaneateles, N.Y., and moved to Santa Barbara, Calif., where I am enjoying condominium living. Professor Victor Homerberg, who once taught at M.I.T., lives nearby and I see him and his wife once in a while. As a hobby, I transcribe books into braille for the blind —a rewarding pastime. "Just had word that Professor Homerberg died."

John F. Dreyer has sent a note. "In my experiments, I came across a unique phenomenon wherein liquid crystals record ultrasonic patterns. My plans were to write a book when I retired, but the above project, which has potential medical applications, intrigues me. I am spending most of my time to see what can be developed with this. I am working in a small laboratory in my back yard. A polarizing and lenscreen business which I started sometime ago is doing well. I have arranged it so that I can leave it alone at will. This is the Golden Age with the pressure off. Regards to all."—**Karnig S. Dinjian** Secretary, 6000

N. Ocean Blvd., Fort Lauderdale, Fla. 33308

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Gaynor H. Langsdorf retired last July 1 from the Standard Oil Co., of California, after more than 38 years of activity in engineering, refinery operation, petrochemical business, financial and appropriation control, and finally Manager of the Executive Development Dept. . . . **Sidney B. Jeffreys** very uniquely tied the 25th anniversary of the organization of his company, Jeffreys Engineering and Equipment Co., to the 200th anniversary of Guilford County, N.C. The combination received many plaudits in the local press as well as the Virginia Tech magazine *Context*. Sid received his master's degree in 1932. Since then he has been very active in the tri-state area of Virginia, North, and South Carolina, both in business and civic affairs. His interests include many avocations in the fields of travel, photography, art, and church work.—**John W. Flatley**, Secretary, 6652-32nd St. N.W., Washington, D.C. 20015

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We have a rather long one from **Cal Mohr** this time, though most of it is philosophical, and perhaps controversial. Cal makes every effort to contact classmates wherever he goes, but, this time he has had no success. A recent meeting of the M.I.T. Club of Chicago saw Cal only, among all our classmates in that area. This, of course, is deplorable. My thanks, Cal, for trying. . . . **John MacIsaac** comes through with quite a document. His job requires plenty of travel. A year ago, he attended an International Textile Show in Paris; he dislikes Paris, for his own reasons, which differ from mine. After this show, he took a short trip to Belgium, Germany, and Austria, getting up to date on the same textile equipment. Within a month he took another trip, this time to Italy, England, France, Germany and Austria, plus Czechoslovakia, where he visited a town called Sumperk, accompanied by a German who knew the country. He was glad to get out of there as he was watched constantly though the country was fascinating. Following this trip, John had a few weeks in the hospital, having picked up the bug.

The MacIsaac's last child has finished college (the son who had a need for the navy before college). In January, 1972, they took a short cruise in the Caribbean on the *Elizabeth II*; John spent three years at sea with United Fruit right after graduation, so had to compare the area with what he remembered, including the girls who are now 35 years older. Oldest son John, eldest of twins, married last June. The seventh grandchild, as of now, has arrived. As I write, John will be on a ten-day jaunt to Europe, and was not looking forward to it, as he does not like the snow. Another daughter is an oceanographer, and is married to one also. They are putting in a year in Greece, and the MacIsaacs will visit them this January. I hope that none of you regular producers will get miffed to see John getting so much space. I just could not condense it any more than that which you see. John, that was a fine letter, which makes this job easier; many thanks.

Now for three handwritten pages from **Warren Webster**! Warren's wife passed away a couple of years ago, and, since he had retired a few years earlier, he found time on the hands too much for him, so he went into teaching at a private prep school; Plane Geometry, Algebra, Chemistry, Introduction to Calculus, and Biology. This last he never studied in prep school or M.I.T. so had to keep ahead of the class by preparation, each time around. It appears that this program was harder work than he ever did in his life, and, after a real try, he quit and started private tutoring. Warren lists his hobbies, to wit: women, liquor (now in much moderation, see: liver), stamp collecting, as well as currency collecting, coins and paper. He avers that he is an avid student still, which is understandable. He studies astronomy, glaciers, earthquakes, and geological natural history. He admits that he does none of these too well, but allows that he does one thing well: duplicate bridge, a sport in which he is a national master. Well, Warren, I expect that Leona does remember you, but, I will make inquiry, or if you can wait until June, you can ask yourself. Many thanks, indeed.

Charlie Cashman comes through with a shorter, but just as interesting a story. You will all recall our reporting Charlie as becoming a lawyer. So, last year, he retired from the paper division of the Weyerhaeuser Co., and is now practicing law, having gone to B.C. law school for four years at night. He was with Weyerhaeuser for 25 years, and finished as Technical Director. He makes no mention of the practice of law in any detail, but does appear to be civic-minded enough to serve as Chairman of the Fitchburg Board of Zoning Appeals; an appointive job, acquired by arm twisting by the Mayor. Charlie tells us that he got interested in the law when he was appointed, in the service, to the defense end of a court martial, never having seen a law book before. Charlie still hunts birds and bears in Vermont. He also does a lot of surface trolling for something, around Cape Cod and Martha's Vineyard; does some drinking and carousing, as learned at M.I.T. Seriously, thanks a million, Charlie.

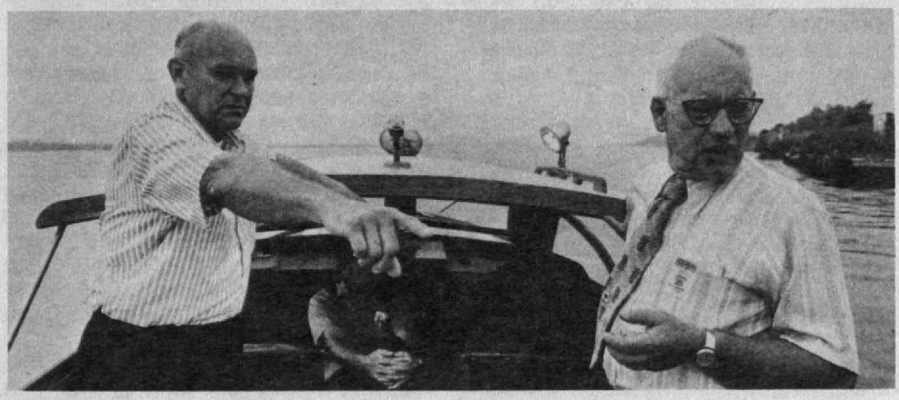
Prentiss Lobdell sends us heart-warming greetings. He is retired now three years from "Dear old Esso," and further, the Lobdells, Marge and Prentiss, are living in a rental at Longboat Key, Sarasota, Fla., awaiting the completion of their brand new condominium. Prentiss says that they have a beautiful spot in a fine, cultural center. Well, son, my son used to be Chairman of the Board of County Commissioners of that particular county, and is now a State Senator. Look him up, folks; he might be able to do some good. All classmates are invited to drop in, though he gave no permission for me to quote an address. As of now, Prentiss and Marge are planning to stay in Florida until May, next, then drive leisurely to the 40th, and then drive across the country to visit the Canadian Rockies. So we will see them at Chatham Bars Inn. Our sincere thanks, Prentiss and Marge.

I sent Father **Bernard Doucette** one of my earlier circular letters asking for news, and received the following reply from another of the Jesuit Scientists, from which I quote, ". . . and am sorry to say that Father 'Bernie' has been confined to his bed, or a wheel chair, for almost three years, after having had one major stroke, and several others since then. Only occasionally can we visit with him to hold even a short conversation." Fellows, if any of you recall Father Bernie, when he was a special student in Aeronautics, I know that he would appreciate hearing from you. I gather that he does listen to personal messages, and knows what is said. Perhaps you will recall that Father Bernie has spent his life in astronomy, and most of it in the Manila Observatory, Philippines, operated by the Jesuit Fathers. In any event, we wish Bernie better things.

Harry Summer comes through with his bit. "I plan to make the 40th, because as one great wit has said, "who is to guarantee the 50th?" Wife, Cecile, says that they might as well attend the big event, as the days of the diaper are past, and/or not yet in sight. Haw! Thanks, Harry.

Now for a few short ones, cards *et al.* Charalee, and **Dick Fosset**, as of October, were on a long auto trip from Norway to Spain. They hiked a little in Norway, until the snow drove them out. They passed through the beautiful city of Geneva, it was overcrowded, and went on, presumably to Spain. Dick writes, "We hope to be home soon, and will definitely make the 40th." . . . Also in October, we had a card from Lucy and **George Henning** who were then travelling in Spain, Portugal and Switzerland, and not necessarily in that order. "All new places for us and very interesting." The card was from Madeira. Thanks, good folks.

Mal Masters writes of his early retirement from Boston Edison, after 35 years. Mal, it appears, led a few canoe trips for the Appalachian Mountain Club this summer, and also took part in their hiking program. With the left hand, Mal does some volunteer work in Middlesex Fells, keeping 21 miles of trail in good condition. Summing it up, Mal needs and gets whatever it takes to keep outta mischief. Claire and Mal were, then, on their way to South Bend, to visit son Stan and family. Stan is a Professor of Economics at Notre Dame. Now, sez Mal, comes the travels, which ought to start this winter. Many thanks for the fine note, Mal. . . . We have a breezy note from **Dick Payzant**, now in Illinois, who says, "better late than never." It sort of reminds me of something biblical, about the lamb returning to the fold. Dick recently attended an award dinner at the Chicago Engineer's Club, where the Award of Merit was made to National Accelerator Labs for the construction of the complex at Batavia, Ill. by the A.S.C.E. Later this month, the Payzants will spend 15 days on the Florida west coast, with son John and his wife, Carolyn; and



W. Vernon Osgood, '36, Environmental Coordinator for the Sabine River Works of E. I. du Pont de Nemours and Co., is the balding man in dark-rimmed glasses in these pictures. He divides his time between field studies on the river, laboratory work, and conferences with public officials. Environmental controls, he told William M. Chambless of du Pont's Context *magazine late last year, are "going pretty well. I think we've begun to win the battle."*

How Much Ecology Is Too Much? Vernon Osgood Is a "Moderate"

W. Vernon Osgood's interest in the environment goes back to his boyhood in Malden, Mass., even before he entered M.I.T.; he remembers the clean air and water of summers in Maine, where "my greatest pleasure was being out in the woods and hills."

But now he wonders if we're going too far.

Mr. Osgood, who graduated in chemical engineering from M.I.T. in 1936, is now the Environmental Coordinator at du Pont's Sabine River Works near Orange, Texas. As such, he is responsible for the plant's extensive pollution control program. That includes engineering supervision, monitoring, working with local agencies, designing new facilities—a full range of environmental protection efforts.

But despite his commitment to his job—Mr. Osgood has been with du Pont for 35 years, held part-time pollution control responsibilities since 1960, and came into his present job on a full-time basis in 1970—Mr. Osgood considers himself "an ecology moderate," he told William M. Chambless late last year in an interview for du Pont's *Context* magazine. "I think we may be overreacting—going for a high degree of cleanup that we as a society can't afford, setting up too many restrictions, going beyond what's needed to the detriment of other problems that also need solving," Mr. Osgood said.

"There's still a lot we don't know," and to find it will take time. For example, in 1971 Mr. Osgood—suspicious that all the hydrocarbons in the Texas atmosphere didn't come from factories and refineries and automobiles—spent 12 days monitoring the air on a remote Texas beach. He was right: "the natural flow of hydrocarbons in the air from the Gulf of Mexico was 20 times greater than the emissions from all the man-made sources in Orange and Jefferson counties," he told Mr. Chambless. Such data are needed before anyone can make sensible regulations, but much of it is still missing.

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granddaughter, little Jennifer, on their ketch, *Menkar*. Gee, I almost left out Emma, who will also be among the sailors. It appears that Dick is still very active, as he just finished three weeks getting a new auditorium ready for the 6th annual International High Energy Physics Conference. Dick is Assistant Project Engineer for D.U.S.A.F., a job which will end next June, after four years of converting 6800 acres of prairie into the world's most powerful cyclotron "atom smasher."

This time we do have a few address changes. William A. Andrews, William E. Baur, Gorham Cluett, Thomas K. Fitzpatrick, Ivan Getting, John G. Hayes, Harrison L. Jewett, Dr. Lawrence Kingsland, Jr., William B. Klee, Benjamin Liberfarb, Prentiss Lobdell, Maxwell D.V. Millard, O. H. Somers, Norman P. Spofford. All these are available to all, with the usual conditions. That's it for March/April. In case you have not been listening, our 40th Reunion comes up in just three months. Though I have made no count, my impression is that this could well be the biggest of all our reunions (except the 25th), and may be for the Institute, leaving out all 25ths. More and more of the faithful are saying that they will definitely be there. Please send your intentions to **George A. Stoll**, RFD 3, 45 Taylor St., Pembroke, Mass. 02359, Registration Chairman. A donation to the 40th Fund is not required for admission to the Chatham Bars Inn, but it sure ought to help. I fear that I will have to attend this event, if only as attorney for the defense.

So, three months to go, and good luck. Best regards—**Warren J. Henderson**, Secretary, 1079 Hillsboro Beach, Pompano Beach, Fla. 33062

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There's nothing to bring joy faster to heart than to open the mail and find that someone in the Class has actually taken the time to sit down and write to you. And so it was a real Christmas present when I received the following from **George Westefeld**—"While reading the December *Technology Review* it occurred to me that perhaps I should send in some news myself. After working for Anaconda American Brass Co., since graduation in 1934, I retired last February, 1972, receiving a full pension.

"For three months during the spring I was asked to travel to Mexico City for Anaconda with my wife Ruth to work for Nacional de Cobre assisting in the installation of rolling mill equipment removed from our Ansonia, Connecticut plant. We stayed there for three months, returning in May. During the summer I studied the real-estate questions and in October received my state license.

"From 1969 to 1972 I was Alumni Fund Chairman in the Waterbury, Connecticut District. We have two children and three grandchildren; we are both enjoying retirement and plan to stay in Chesire, selling real estate and travelling occasionally. We hope to make our 40th in 1974." I hope you can, too, George, and thanks for the newsy letter. Will it inspire some others?

I have also received what seems to be the Christmas letter sent out by **Cassius Belden** and his wife Leta from Baie d'Urfe, P.Q., Canada. It is shivery how closely the first part parallels my own experience of last spring. Their letter reads, "What started out as a perfectly normal year for the Beldens turned out to be quite a memorable one. All went as usual—curling for Cassius, bridge for Leta and an occasional night out for both—until April 28 when Cassius took an unexpected trip (by ambulance) to the Queen Elizabeth hospital as the result of a heart attack. Fortunately it was a 'mild' attack and he was discharged from the hospital on May 15 for a recuperating period of about a month at home.

"Ron graduated from Bishop's University in Lennoxville and the Convocation was held there on May 27. This was a must, so with Leta driving, we attended. We also decided to use the 'recuperative period' to resume our search for a summer home in Ontario. We became the proud owners of about an acre of wooded land with 200 feet of shoreline on lovely Charleston Lake. With the property went a completely furnished cottage.

We had carpenters, plumbers and electricians around for most of the summer. It was a hectic but wonderful summer. We spent our (Canadian) Thanksgiving weekend at the cottage and had both boys and Ron's Doreen with us. We closed the place the following weekend for the winter and since then life has returned to something near normal." It is good to read that Cassius' attack was so mild—having "been there" myself I feel we may be lucky to have received warnings that will keep us from future serious trouble.

I have several Alumni Fund notes but will save some of them, plus a note from Jim Eder for next issue. But let me quote from **Henry Andrews**, "I spent a semester at Cambridge University two years ago gathering data for a History of Paleobotany. Last summer continued my paleobotanical research in northern Maine and along the New Brunswick coast searching for early land plants of the Devonian period. Had about the best luck of my entire career—found quite a few 'new' plants which we are now working up in the lab."

By the time this issue comes out you will have read in the February issue about possible "Mini-Reunions" and this issue should carry more information. Since I will be in Europe in late April, May, and early June, I'm asking that all of you who might be interested to get in touch with **George Bull**. We would need 30 to support a private bar, but if not that many are interested, we could probably join forces with '33 and '35.—**Robert M. Franklin**, Secretary, Satucket Rd., Brewster, Mass. 02631; **George G. Bull**, Assistant Secretary, 4961 Allan Rd., Washington, D.C. 20016

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Robert J. Anderson writes from a spot where most of us would like to be: "Retired to Sarasota, Fla., part time since last September, full time as of February 1, '73. It sure is great to live in this warm sun of the south. My wife, Barbara, and I are thoroughly enjoying the easy living and the friendly people of this area." . . . **Arthur H. Cohen** writes from Waltham in an area where most of us are: "My youngest daughter Eileen was married to Joseph Kane of Skokie, Ill., last May 28. She is teaching Histology at Tufts Medical School after receiving her Ph.D. in Anatomy at Harvard Medical School last June."

Laurence A. Stone writes: "Still employed by Headquarters U.S. Army Materiel Command in Washington, D.C. I am responsible for in-plant reviews of the management systems of large defense contractors to assure that they meet the D.O.D. standards of acceptability with respect to cost and schedule control." . . . **Ham Dow** has written about his and Edith's two-week trip last fall to Spain and Portugal with two overnight stops in Paris. "While in Spain's Costa del Sol I managed two rounds of golf with rented clubs. The first was at the Campo de Golf Malaga, a par 71, 6390 yards, fairly flat. The other was at the Nueva Andalucia just west of Marbella. This is a spectacular Robert Trent Jones course, par 70, 6220 yards, hilly and very plush with no power carts allowed. My partners at the latter course were from our General Electric tour group but had two interesting men from Iceland to play with at Campo Malaga." . . . Continuing on golf for a moment, **Ned Collins** and I are on Dwight Arnold's Golf Committee along with Norris McSweeney, '49. This is a committee of the M.I.T. Club of Boston whose President is another '35er, **Rush B. Lincoln**. We are one of several regional committees involved in arranging an Alumni Golf Tournament which you will be reading about in the *Review* outside these notes. Our own Class tournament goes into its fourteenth year this season.

If you want more news in these notes, please write to—**Allan Q. Mowatt**, Secretary, 61 Beaumont Ave., Newtonville, Mass. 02160

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Very welcome contributions to the Alumni Fund have also brought news to your Secretary, also very welcome. **Walt MacAdam** writes that he has been elected to a third term as President of United Engineering Trustees, Inc., and to the Board of Directors of the New York Engineers Club. By the time you read this, he will have retired from full-time employment. His plan is to go into consulting—no more than two to three days a week. I certainly hope it all works out as planned. . . . **Ben Fogler** has returned to Cambridge after nearly three years in Belo Horizonte, Brazil, where he was Director of a 40-man team doing industrial feasibility studies for the state of Minos Gerais. The Foglers are back living in Lexington and Ben is back with Arthur D. Little, Inc. . . . **Roman Ulans** has moved to Singapore to establish a new Far East Office for COMSAT. He has been with COMSAT since his retirement from the Army Signal Corps as a Colonel in 1966. . . . **Martin Gilman** writes, "Although no longer at a full-time job, I am busier than ever, it seems. Much of the time involves church and volunteer work. My wife and I are starting our fifth year tutoring foreign-born children in a Cambridge school under their volunteer project. The first year, we worked with the daughter of our own Katherine Odiorne ('39), who was then a teacher." . . . **Larry Kanters** writes that his work takes him from "Tomahawk, Wisc. to Red Lodge, Mont., with way stops in Blackduck, Minn., and Killdeer, N.D." He continues that it "sure beats life in the teeming cities where I previously worked."

The *Review* office has sent to me a reprint of a most interesting article about **Vernon Osgood**. The source is unidentified, but it looks to me like a DuPont house organ. Be that as it may, "our hero" is environmental coordinator at Du Pont's Sabine River works near Orange, Texas, responsible for the plant's pollution control program. He also serves as an officer or active member of ten local, state, or national pollution control bodies; testifying at hearings on proposed regulations, preparing technical papers for environmental conferences, and speaking before civic, school and conservation groups. He became involved full time two years ago although he has been concerned with pollution problems since 1960. . . . From two sources—The American Chemical Society and the *Boston Globe*, we learn that **Bob Woodward** is in the news again. In December, it was announced that he

and Professor Roald Hoffman of Cornell would share the A.C.S. Arthur C. Cope Award for outstanding contributions to organic chemistry. They are being honored for their "Woodward-Hoffman rules" that allow organic chemists to predict correctly the feasibility and results of many experiments. These rules of "orbital symmetry"—first introduced in 1965—have been called the most significant theoretical advance in organic chemistry in 30 years. In January, it was announced that researchers under Bob's direction, working with chemists at the Federal Institute of Technology in Zurich, after 11 years had succeeded in synthesizing vitamin B12. Congratulations to you all.—**Alice H. Kimball**, Secretary, P.O. Box 31, West Hartland, Conn. 06091

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George R. Weppler, Chairman of the Board and President of Harvey Hubbell, Inc., was reelected to a three-year term on the Board of Governors of the National Electrical Manufacturers Association. George also serves as a Director of Harvey Hubbell of Canada, Ltd., Harvey Hubbell Ltd., in London, Waterford Electric Co., Ltd., in Waterford, Herts, England, and the Kerite Co., Seymour, Conn. He is also a Trustee of the University of Bridgeport and the Park City Hospital and the People's Savings bank. . . . **Harry Wallin** has recently taken over the duties as Manager of construction of an 1130 megawatt nuclear power plant, called Trojan, being built for Portland General Electric Co., near Rainier, Oregon. Beehtel has the contract to do the engineering and manage the construction. They are scheduled to complete construction in 1974. . . . **Frank Lewis** has one son, Peter E., at M.I.T. as a sophomore and another son, Robert L., at Carnegie-Mellon. Frank is still active as Assistant Scoutmaster of Troop 195, Lexington, Mass. He is Chief Engineer of James Miller Manufacturing Co. Inc., and occasionally writes articles for technical journals.

Gardner Murray has retired as Division Engineer-Buildings from Anaconda American Brass Co., in Waterbury, Conn. Your Secretary, **Bob Thorson**, is still President of Thor Roofing Co., Medford, Mass., as well as Thor Co. He is a Past President of the Rotary Club of Medford, a Director of the Lawrence Memorial Hospital, Medford, as well as the Hillside-Cambridge Cooperative Bank. His stepdaughter, Kathleen Collins, was married on December 18, 1972 in Dallas, Texas, to Randall W. McNatt. Kathy is a stewardess for Braniff International Airlines. Bob and his wife, Rose, keep busy during the winter, curling at the Winchester Country Club.—**Robert H. Thorson**, Secretary, 506 Riverside Ave., Medford, Mass. 02155; **Lester H. Klashman**, Assistant Secretary, P.O. Box 961, Peabody, Mass. 01960

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I am becoming increasingly aware of advancing years, particularly when the Christmas mail came in. **Fred Kolb** and **Bob Treat** wrote particularly of the doings of their grandchildren. In the mail also was a note from **Arch Copeland**, who regrets that he will not be in London during the Class Reunion. This brings up the subject of your own attendance. Just make good and sure that you have blocked off June 1 to 3 for our 35th Reunion at Stratton Mountain. Don Severance and Paul Black assure me that early June is just an unbelievable time of year to be in Vermont.

John Craig is heading up a restructuring of the engineering function of Southern New England Telephone Co. John is a Vice President of the Company, and presently resides in Woodbridge, Conn. . . . **Dave Baker** writes that he is Chairman of Hugh J. Baker and Co. "This is my principal job but I also serve as a member of the Board of Corrections of the State of Indiana; member of the Board of Trustees of National Council on Crime and Delinquency; President of the Town Board of Meridian Hills. Several times a year I have the opportunity to meet with college classes."

John A. Hilcken retired from the U.S. Army in April, 1971 after 30-plus years service. He has since been employed as public health engineer for Arlington County Environmental Health Bureau, a fun job (two miles or eight minutes from home) dabbling in air and water pollution control, building plans review, swimming pools, and even some toxicology.—**A. L. Bruneau**, Jr., Secretary, Hurdman and Cranstoun, Penney and Co., 140 Broadway, New York, N.Y. 10005

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For the lead item this month, Dr. **Harold Chestnut** has been elected President of the Institute of Electrical and Electronics Engineers, Inc., Hal, currently Vice President of Regional Activities of the I.E.E.E., is a consultant, Systems Engineering, Information Science and Engineering, General Electric Corporate Research and Development, Schenectady, N.Y. To repeat some of Hal's accomplishments that have appeared in these Class Notes over the years, he was awarded an honorary Doctorate in Engineering from Case Institute of Technology, has authored several books in the John Wiley Series on Systems Engineering and Analysis, and coauthored a two-volume book *Servomechanisms and Regulating Systems Design.*

Wesley A. Kuhrt, President of the Sikorsky Aircraft Division of United Aircraft Corp., was among 19 new Fellows of the American Institute of Aeronautics and Astronautics honored at the Honors Night Banquet January 10 in Washington, D.C. Fellows are persons of distinction in aeronautics and astronautics who have made notable and valuable contributions to the arts, sciences, or technology in their field. Mr. Kuhrt's citation read in part: "For his career work in the forefront of research and development of internal combustion engines, plasma physics, nuclear power, and magnetohydrodynamics." . . . Professor F. L. Foster, '25, forwarded a Christmas letter from one of his former Course III students, **Ramon (Mike) Sevilla**. Mike and his wife Elisa have kept in touch with Professor Foster over the years, and his letter spoke of his family activities in agriculture. He grows fruit for wines to export, and raises hogs and cattle. He wrote also of **Tony Diokno**, also '39, who is active in the investment field and also heads the Cement Association of the Philippines. Tony is Chairman of one of that country's leading cement producers. . . . **Dave Bartlett** wrote that he was very involved in the successful campaign of his brother Dewey for the U.S. Senate, from Oklahoma. . . . **Ida R. Gordon** noted that she does special projects in market research and writing for her husband Robert Gordon, Director of Research at Sartorius and Co., stock brokers, in New York City. . . . **James A. Smith** wrote: "Am busy publishing a weekly newspaper for Brooklyn in five regional editions. We plan to become Brooklyn's first daily newspaper since the death of the old *Brooklyn Eagle* 18 years ago. Nothing in M.I.T.'s curriculum can match the experience of starting one's own business with 30-plus employees!"

Captain **Bradley F. Bennett** wrote that he is Vice President for Administration of Universities Research Association, a non-profit corporation which is a consortium of 52 universities, including M.I.T. The Association is building and beginning to operate the National Accelerator Laboratory and its proton synchrotron, currently 400 GeV. . . . **William H. Phillips** presented a paper at the M.I.T. Symposium on "The Technology and Science of Motorless Flight." He wrote that his own participation in soaring is confined to radio-controlled models, but that **Ben Badenoch**, a member of the glider club in student days, is still active in full-scale soaring. **Peter M. Bernays**' note on the back of his Alumni Fund envelope said that he is Assistant Manager of the Physical Inorganic Analytical Chemistry Department at Chemical Abstracts. Finally **Dave Lindberg** noted that he was honored by a four-year appointment to the Juvenile Justice and Delinquency Prevention Commissions of Sacramento County. These unpaid appointments are made by the presiding judge of the Superior Court. This new work of Dave's ties in with his remotivation activities with ex-convicts and juveniles. He said that this new appointment promises to give him some rewarding experiences.

The "New England Report," published by the First National Bank of Boston, had some good things to say about Governor **Frank Sargent**'s efforts to increase prosperity in Massachusetts, in establishing a special program to face up to the realities of the State economy. —**Oswald Stewart**, Secretary, 3395 Green Meadow Circle, Bethlehem, Penn. 18017

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Your Secretary is in receipt of the interesting Christmas message from Marion and **Gary Wright**: "The news of the year for the Garrett Wright family was the safe arrival of two new grandsons. Marcus Alexander Burtner joined two-year old Matthew in Anchorage on May 12.

Lucanus Nadeau was born in Madison, Wisc., on July 16. What happiness to have three handsome healthy grandsons! Marion was in Anchorage before Marcus arrived. Garrett followed in late May, and in June we all flew to Naknek. It was a treat for us to see the little community on the edge of the Aleutians. We returned to Springfield by way of Oregon and San Francisco (three busy days with Mom, Irma and Gary, Virginia and other dear ones). Since Janet expected her baby in late June we had arranged to take the second shift on helping her. We drove to Madison when the baby was two weeks old and met him then.

In addition to "grandparenting" we have spent six weeks or so in Kitty Hawk—split between a work session in April and a more leisurely relaxed time in September. Virginia flew to Missouri on Labor Day and accompanied us on a lovely trip through the South en-route to Surfview. October was our company month, with Ginny staying on a few weeks, then a visit from Irma and Gary, and finally Louise and Jack Loughridge spent a few short days. We have sold the Texas farm land and are concentrating on the Golden Spread in Missouri. With a new family in residence, 14 fine new calves, a mobile home in place, and untold vicissitudes behind us, we can finally see a faint glimmer of light ahead. Even though we are often divided by miles from our family and friends, we are always united by love."

It is with regret that I must report the death of **Joseph Kripke** on July 4, 1972. While I do not have information of his activities in the last few years, at the time of our 25th Reunion Joe summarized his life since leaving Tech: "Left M.I.T. primarily as an inventor but have served as Government Project Engineer, a Mechanical Designer, a Chief Engineer, an engineering administrator, a ballistician, etc. After 1940 came engineering careers with the air force, with N.A.C.A., an independent armament design co., and the last 17 years with G.M. With my current employer I was engaged in aircraft armament and space work but have been spending the most recent time in the highly enjoyable field of invention with the G.M. Styling Staff at the G.M. Technical Center, Warren, Mich. To do the kind of work one wants to do requires a cooperative family. Mrs. K. (Dorothy) serves up the cooperation while husband invents, and offspring, Ned, age 14, Joan, age 12 and Elizabeth, age 3, keep the homestead booming."

Amos E. Joel, Jr., is one of two inventors to receive, on November 16, 1972, the Outstanding Patent Award from the New Jersey Council for Research and Development. He is the coinventor of a telephone traffic system whose projected equipment value is rapidly approaching one billion dollars. Amos is a switching consultant at Bell Laboratories. . . . **Winfield James** has just become Chief Executive Officer of the *New York Daily News*. Formerly he was President of the company. . . . **Fred Henrickson** retired on October 31, 1972 after 31 years with Allied Chemical and now is a consulting engineer with projects in heavy chemicals and fuels. . . . **H. Tyler**

The Most Famous Product of "Creative Failure"

The transistor as a success story began in December, 1947, when William Shockley, Ph.D.'36, and two other scientists at Bell Telephone Laboratories—John Bardeen and Walter Brattain—succeeded in emplifying an electronic signal by sending it through a very specially prepared crystal of germanium. The invention was demonstrated to the public on June 30, 1948—which makes this its 25th anniversary year.

In that space of time the transistor has led to an electronics revolution the extent of which could hardly have been foreseen even by those who chose to give its inventors the Nobel Prize in Physics in 1956. It has become—in the language of Bell System press agentry—"virtually ubiquitous in American life. Most people are never more than a few feet away from a transistor."

To date Western Electric—Bell System's manufacturer—has made millions of separate transistors and over 7 million integrated circuits. No one knows how many transistors have been made, in all; but sales of all types of solid-state devices in the U.S., Europe, and Japan reached $2.5 billion in 1971 and probably $2.7 billion in 1972.

In a 1972 paper in *Popular Science* (New Scientist, *December 21, 1972, pp. 689-91*), Dr. Shockley describes the process leading up to the transistor as "a complex organizational effort characterized by . . . 'creative failure' methodology—using failures as opportunities to learn and move ahead."

The first notion of a copper oxide crystal for electronic amplification came to Dr. Shockley while he was working at home in December, 1939. Some discouraging experiments began in 1940, but only after the distractions of World War II could Bell Laboratories groups really go to work on the idea. The first efforts didn't work at all, and—an application of the "creative failure" methodology—Drs. Brattain and Bardeen switched to germanium. Success followed quickly, and Dr. Shockley describes his reaction: "My elation with the group's success was balanced by the frustration of not being one of (the germanium point-contact transistor's) inventors."

So for the next five years Dr. Shockley busied himself with developing improvements which extended Bell Labs' patent position, and in the course of that effort he fell into his own most interesting result: "My most important inventive breakthrough came not while I was trying to invent a transistor but while designing an experiment to diagnose incisively the surface phenomena of point-contact transistors. The structure I devised, I suddenly realized, was itself a transistor. It was patented as the junction transistor.

"I was disconcerted to realize that for at least a year I had known all the concepts needed for the invention, but had not put them together until the point-contact transistor provided the challenging stimulus."

Drs. John Bardeen, William Shockley, Ph.D.'36, and Walter H. Brattain (right) are shown above at Bell Telephone Laboratories in 1948 with the apparatus used in the investigations which led to the invention of the transistor. Twenty-five years later the three held a reunion (below) to mark the 25th anniversary of their invention which has revolutionized electronics—and which brought them the 1956 Nobel Prize in Physics.

Amos E. Joel, '40, (right) accepts the Leonard G. Abraham Prize Paper Award from Alan Culberston, President, I.E.E.E. Communications Society.

Marcy advises that he is in the midst of serving for one year term as President of the Instrument Society of America. The society has 20,000 members and is concerned with measurement and control. . . . **Ed Adams** is the Patent Attorney/Director of Bell Laboratories in Holmdel, N.J., where he has been for 26 years. Two of his sons were married this year and the third and last is a junior at Yale and is considering entering law.

Charles Fitter notes: "Still traveling through Asia, Africa and the Middle East as Kodak's Director of Marketing for that region. Would be pleased to hear of classmates or other M.I.T.'ers located in the major cities of this rather large region. Object—to raise a stein together." . . . **Abe Rockwood** writes that his two oldest boys are attending Florida Institute of Technology. . . . The final bit of news this month is from **Lester Lees** who writes: "Since early 1971 have been Director of the new Environmental Quality Lab at Cal Tech. We now have an intern disciplinary group of social scientists, lawyers, engineers, scientists and graduate and undergraduate students working on strategic problems of the environment. My son David graduated from U.C.L.A. and is now married and on his way."—Write **Al Guttag**, Secretary, Cushman, Darby and Cushman, 1801 K Street, N.W., Washington, D.C. 20006

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Robert S. (Hawkshaw) Shaw writes, "I presently make more successful efforts to apply what I learned in Course 7-A in the Courts and as an expert witness. Like M.I.T.'s Ellsberg I am personally embroiled in litigation involving the Justice Department, but on the other side. I am on a committee appointed by Governor-elect Meldrim Thomson of New Hampshire to clean quackery in the name of 'Mental Health' out of the New Hampshire government. I retain great interest in *Mens et Manus* and am particularly interested in seeing M.I.T. establish a working relationship with Zhores Medvedev." Bob, we sure would be interested in some further information about your relationship with Zhores Medvedev!

Carl Jealous is now located 8,000 feet up on the eastern side of the Sierra Mountains near Bishop, Calif. He is in charge of Union Carbide's environmental improvement project treating liquid wastes from the tungsten mining and milling operations there. From here it sounds like a challenging assignment in a really remote spot. However, Carl writes that it is magnificent country with fine climate and offers a wonderful place for golfing, etc. . . . An article in the Manchester, New Hampshire *Union Leader* reports **Mort Goulder**'s appointment to the Board of Overseers of the Crotched Mountain Center. The center, now in its twentieth year, is one of the nation's leading facilities for the education and treatment of multiple handicapped children. . . . Another of our classmates living up in the mountains is Colonel **Roger H. Olson** who is in Boulder, Colo., and doing meteorological research on solar-weather relationships.

Our annual report from **Bob Howard** finds his clan still based at Huntsville, with one daughter, Angelika, at Cornell, another daughter, Lourana, teaching science in Tampa, Fla., son Bob at Georgia Tech. Tom and Jack are still in high school. . . . **Bob Curtis** is keeping busy as Manager of the Yacht and Boat Division of Electro Nav and as a partner in Curling Associates, both in Connecticut. This year he was navigator on one of the boats in the Bermuda race and won a small piece of silver at the New York Yacht Club Regatta. . . . **Alan Macnee** writes that he has just completed a pleasant sabbatical year with the Labor and High Energy Astrophysics at Goddard Space Flight Center. He is now back at his old stamping grounds in the Department of Electrical and Computer Engineering at the University of Michigan.

Jack Sheetz, Vice President of Resources at Tufts is back in print, this time in a recent issue of the Tufts *Criterion*. Jack is very active in Tufts P.E.P. (Personnel Enrichment Program) which is the continuing education program there. . . . **Charlie Estes** writes that his wife passed away in October. Our sincere condolences to him and to his family. Charlie has left Motorola's Applied Systems Unit in Riverside, Calif., and is now associated with the New Ventures Corporate Group in Scottsdale, Ariz.—**L. K. Rosett**, Secretary, 191 Albemarle Rd., White Plains, N.Y. 10605

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Oh, how the months do go by so quickly! We are sorry to again have missed a recent issue but regrettably there have been no reports from you.

We received a note from **Warren H. Turner** which has inspired us to report on Warren's activities in the past years—information which we drew from the 25th reunion book and Warren's note. Warren remained in the navy following graduation until December, 1946. He then joined New Jersey Bell Telephone Co., in early 1947 and had varied assignments in traffic engineering and supervision. Warren and Lee Miller were married in May, 1951, and in June, Warren was recalled to duty with the 6th Fleet in the Mediterranean. This tour of duty as operations officer on an ammunition ship continued to 1953 when he returned to New Jersey Bell. In 1958, Warren was selected to attend the Bell System's Institute for Humanistic Studies at the University of Pennsylvania. Warren was surprised to be joined by his former roommate, Doug Watson, and they and their families had a pleasant ten months. In 1963, Warren joined A.T. and T. and in 1967 became Engineering Director, Systems Planning. In this assignment he provides technical long-range planning guidance to the Bell companies. More recently, Warren heads a section furnishing staff advice to Bell building and equipment engineers.

The Turner family of Warren, Lee and children, Pam, Cindi and Rich, live in Convent Station, N.J. Pam is at Bucknell and Cindi at E.C.U. Rich is nearly 12, but Warren says he has no interest in M.I.T. yet.

Since 1964 **Robert F. Neison, Jr.**, has worked for the Naval Scientific and Technical Intelligence Center and is now a GS-14 and titled, Head, Electra-Optic Branch. Bob and the people who work for him are particularly concerned in the use of optical, television and infra-red devices in their weapons systems by the Soviets. Bob, his wife Marianne, and children, Tony, 17, Astrid, 15, Sarah, 12 and Tom, 10, live in Rockville, Md. They have recently returned from a month's vacation in Europe, visiting the Low Countries, England, Germany, France, Denmark, and Iceland.

Lewis T. Mann has joined the University of Connecticut Health Center, Department of Radiology. He is setting up a lab in the field of radioimmuno assay (also called "wet" nuclear medicine). Lewis has had a fantastic career as a immunochemist beginning with Columbia University in 1947, the Riker Lab in 1951, and the U.S. Army Medical Service Corps in 1954. Lewis was a Research Fellow in transplantation immunology at Harvard Medical School for the period 1956-1966 and a National Institute of General Sciences Fellow (England and Denmark) from 1966 to 1968. From 1968 until this new assignment, Lewis has been with the University of Connecticut School of Medicine and the Veterans Administration Hospital. Lewis, his wife, Marilyn, and three children live in Newington, Conn.

Don Burke, has sent us a clipping from the St. Petersburg, Fla., paper which reported the bizarre sky-jacking of the Southern Airways DC-9 in November from Birmingham, Ala., to Detroit, Cleveland, Toronto, Chattanooga, Havana and then Key West to Orlando where the tires were shot out, and then again back to Havana with the ransom money. Our classmate, **Alex Halberstadt**, of Miami was one of the passengers who endured this 29-hour ordeal. . . . **Ned Bowman** is a Professor in the Sloan School at M.I.T. He recently wrote a report for the M.I.T. Corp., "University Investing and Corporate Responsibility". He is now on leave and at the European Institute for Ad-

vanced Studies in Management in Brussels. Ned's son, John, is a freshman at Bowdoin College.

Doug Crinklaw is now with Litton Data Systems as an engineering specialist. His daughter, Donna, is at Cal. Lutheran College, and son, Doug, Jr., is an ensign in the navy at the Nuclear Power School at Bainbridge, Md. . . . **Ernest G. Jaworski** has been elected to the editorial board of *Plant Physiology Journal* and co-chairman of the Gordon Research Conference on plant cell and tissue culture for 1973.

In November, 1972, **Dan Streeter, Jr.**, gave a paper on the relation of the fiber angle to heart shape at the American Heart Association Conference in Dallas.

David M. Hoag and Richard H. Battin, '47, have been selected to share the $10,000 American Institute of Aeronautics and Astronautics' Louis W. Hill Award for 1972. Another well-deserved award for Dave, and our congratulations to him for this award. Until next time.—**Russell K. Dostal**, Secretary, 18837 Palm Circle, Cleveland, Oh. 44126

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The January meeting of the Reunion Committee was well attended. Jack Page traveled the farthest to attend, coming from Dallas, Texas. Other classmates attending the meeting were Arthur Waxman, Verity Smith, Ted Yoos, Marvin Rosenberg, Bob Sandman, Dave Finnegan, Fred Durgin, Sonny Monosson, and yours truly.

Fred Lehman gave a status report about the Centennial Convocation—100 Years of Women Graduates which is scheduled at the same time as our 25th Reunion and is sponsored by the Association of M.I.T. Alumnae. The Convocation is planning to present formal programs on Saturday and Sunday mornings. Workshops on Saturday afternoon are planned in areas such as "What Makes a Woman a Successful Executive?" and "What's Happening at M.I.T. in Women's Programs".

Jack Page, the Chairman of our committee to collect the 25th Reunion Gift, reported on the progress in reaching our Megabuck goal. Jack is cautiously optimistic about reaching the Megabuck Gift, but he is more certain that we will exceed the previous record of $750,000. Jack has committees around the country helping him and he is grateful for their help and for Ken Brock's help. . . . **Leon LaFreniere** was prevented from attending because of the flu, but he sent a report about an excellent country club on the south shore for Friday's program. The club would provide golf, recreation, and eating facilities. Several possible locations for Saturday's dinner dance were considered. The subcommittee will study this further before selecting a location.

The tenor of the meeting was much less relaxed during the discussion of the budget, and the determination of how much we will have to pay in order to attend the Reunion. **Verity Smith** submitted a budget for our consideration. After much discussion and some heated comments, the amount we will have to charge was approved by the committee. A mailing will be made to the entire Class and the details of the charges will be provided to all classmates. The plans for producing a 25th Reunion Yearbook were reviewed. Requests for autobiographical information are to be sent to all classmates. The completed Yearbook will be sent to everyone who provides autobiographical material. Our Yearbook promises to be interesting reading. Approximately 100 classmates have already made their commitment to attend the Reunion. A group of this size insures us of having a fun weekend, and if past classes are an indication we can expect more acceptances from the next mailing.

Phil Bragar has been named an Associate Director of Bedford Administration at the MITRE Corporation's Bedford Operations. Phil will be responsible for Product and facility services. Phil had been Director of General Services for the last two years. Previous assignments included Associate Personnel Director, Director of the Site Administration Office, and Director of Technical Services. . . . The American Institute of Aeronautics and Astronautics honored 19 new Fellows at an Honors Night Banquet on January 13, 1973. Among those honored was **Dan Fink** who was elected a Fellow of A.I.A.A. for his leadership and judgement in develop-strategic and space system requirements for national defense. Dan is Vice-President and General Manager, Space Division, General Electric Co. . . . **Allan Munck** writes that after graduating, "I worked for a year in Argentina as a chemical engineer. Then I returned to M.I.T. for a Ph.D. in Biophysics. Currently I am a Professor of Physiology in Dartmouth Medical School, where, aside from teaching, I devote my time to research on how hormones work. Off hours with my wife and three children, I enjoy the great outdoors, skiing in season."

Harvey Taylor is current Manager, Guidance and Controls Laboratory at Hughes Aircraft Company's Missile Systems Division. . . . **Bill Hosley** resigned from Eastman Kodak Co., last February after 23 years to become President of Vino Corp., Manufacturer of home wine-making equipment, ingredients, and supplies. . . . **Gene Purdum** sent the following note from St. Petersburg: "People are still moving into the St. Petersburg area by the droves, so we're still designing high rises to house them. In another ten years, our St. Petersburg Beach will have a skyline like Miami Beach at the present building rate. . . . **Stan Abkowitz** of Lex-

A.C.S. Links Three Chemists: Cope, Woodward, and Hoffman

A. C. Cope

R. B. Woodward, '36

Arthur C. Cope arrived at M.I.T. to be Professor of Chemistry just seven years after a precocious teenager named Robert B. Woodward had finished bachelor's (1936) and Ph.D. (1937) degrees in organic chemistry here and moved to Harvard as a postdoctoral fellow. The two became friends—though not professional collaborators—as their careers developed in Cambridge in the 1940s and 1950s, Dr. Cope as Head of the M.I.T. Department of Chemistry, Dr. Woodward as an increasingly distinguished member of the Harvard faculty.

The bright spotlight of fame came to rest on Dr. Woodward in 1965 when, after a long series of syntheses of large organic compounds, he was given the Nobel Prize in Chemistry. Before and since then he has received national and international recognition in the form of 22 honorary degrees, 43 honorary lectureships, and 23 scientific awards from universities and scientific organizations in the U.S. and abroad.

Meanwhile, Dr. Cope's leadership brought distinction to the M.I.T. Department of Chemistry as a center for teaching and research, and his indefatigable efforts in behalf of the profession brought him to the Presidency of the American Chemical Society in 1961. Four years later he resigned as Head of the Department, hoping to spend increasing time on teaching and research and to permit a younger man to set the Department's future course. A year later, at age 56, he was dead.

He had been a member of the American Chemical Society's Board of Directors since 1950 and was its Chairman at the time of his death; his 16-year tenure on the Board is the longest in A.C.S. history.

It was through Dr. Cope's will that A.C.S. was provided with resources for a major new prize for "outstanding achievement in the field of organic chemistry," and that prize has now to be given to two organic chemists—Dr. Woodward and Dr. Roald Hoffman of Cornell University.

The first Arthur C. Cope Award—$5,000 for personal use, $15,000 for a research grant in aid, and appropriate gold medals to each recipient—is for the "Woodward-Hoffman" rules which permit an organic chemist to predict if either heat or exposure to light can initiate a reaction between organic substances. It will be given in August, 1973, during the A.C.S. national meeting in Chicago.

Dr. Hoffman, who is Professor of Chemistry at Cornell, was brought to the U.S. from Poland with his parents at age 11, studied at Columbia (B.A. 1958) and Harvard (M.A. 1960, Ph.D. 1962), continued at Harvard as a member of the Society of Fellows until 1965, and joined the Cornell faculty as Associate Professor of Chemistry three years after completing his doctorate.

The choices of Drs. Woodward and Hoffman, says *Chemical and Engineering News*, "ensures the stature of the Cope Award from the very beginning."

ington, President of Dynamet Technology Inc., Burlington recently served as General Chairman for the Second International Conference on Titanium. The conference was held at M.I.T. Kresge Auditorium and covered the complete technology of titanium metallurgy and applications. Stan is the inventor of several commercial titanium alloys used in modern jet engines and is inventor of the titanium alloy originally planned for America's Supersonic Transport. His titanium alloy developments have found application in such diverse application as corrosion resistant valves and surgical implant devices such as the hip prosthesis. Stan is co-author of the book *Titanium in Industry*.

Frank Jamerson is now running the G.M.R. Physics Department and enjoying management during a real expansion period (G.M.R. will grow by 50 per cent over the next five years.) He writes, "Our department research includes studies in optics and physical electronics, surface and solid state physics, chemical physics and magnetics and metal physics. After M.I.T. I went on to a Ph.D. in Physics at Notre Dame, '52. Joined the U.S. Naval Research Lab in Washington, D.C., in 1951, spent 1953 at Westinghouse working on the *SS Nautilus* reactor then back to N.R.L. in 1954. Joined G.M.R. in 1957, and assumed present duties in October 1969. My wife, Joy (Campbell) and I have four sons, Bruce 21, John 19 (both at University of Michigan), Bill 17 and Jim 15 and daughter Sally, who's 5. Hope to see you in June. Best regards."—**S. Martin Billett**, Secretary, 16 Greenwood Ave., Barrington, R.I. 02806

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Only a half-dozen items this time, including two one-liners from Alumni Fund notes. **Nathan Sokal** reports: "Son, Alan, entered Harvard as a sophomore (advanced standing) in Physics, last September." . . . **Norval White** provides a biographical sketch, as follows: M.F.A. (Architecture) Princeton, 1955; independent architectural practice since 1955. Principal works: New York City Police Headquarters (as partner, Gruzen and Partners); Essex Terrace (housing) 1970; Parks from Solid Waste, Brookhaven, Long Island, N.Y., 1973; author, A.I.A. Guide to New York City; Professor and Chairman, School of Architecture, The City College, 1970. Norval also adds that he married Joyce Lee in 1958, and has four sons.

William Haddon, Jr., M.D., reports that he will continue as President of the Washington-based Insurance Institute for Highway Safety, but will also become First President of the newly formed Highway Loss Data Institute. This new, nonprofit organization, established by eight major insurance companies, will develop and apply computer systems to process policy and claim data from the participating companies to produce loss information for individual makes and models of automobiles. The information will include analysis of claim frequencies and of the frequencies and severities of the mechanical-energy damage to people and property associated with their use. The Institute will publish the results of this and other research in scientific journals and other media, and will make the results available to the public. It is already following the loss experience under collision coverages of well in excess of one million 1972 and 1973 vehicles.

In an August issue of the *Richmond News Leader*, **Garland Sydnor, Jr.**, appears as President of Sydnor Hydrodynamics Inc., a firm with $4 million annual sales, about 20 per cent of which involves a waste treatment components system, including floating aerators, called "oxygenators." The oxygenator and other prefabricated components of Sydnor's waste treatment system can reduce construction cost of waste treatment plants by one half, since the plants can be constructed and later dismantled relatively inexpensively.

On December 20, 1972, **Marvin A. Asnes** was elected to Executive Vice President of Becton, Dickinson and Co. Fairleigh S. Dickinson, Jr., Chairman of the Board and Chief Executive Officer, commented that "the company had planned for some time to include Mr. Asnes in senior management, not only to share in policy and operational burdens but more importantly, to provide for an orderly transfer of leadership responsibilities. Marvin Asnes has contributed substantially to our success, and possesses the experience and capabilities necessary to direct the company's growth."

In his 18 years with the company, Mr. Asnes has successfully coordinated several companies acquired by Becton-Dickinson, with products ranging from disposable laboratory ware and instrument and diagnostic kits for the doctor and laboratory, to sophisticated electronic equipment used in hospital intensive care units. The company's industrial electronics division, also in Mr. Asnes' sphere, has diversified profitably from government areas into the industrial sector, serving the computer, commercial airline, and automotive industries. Mr. Asnes has previously served Becton-Dickinson as an Executive Vice President and a Group Vice President. He came with the parent company when Clay Adams, of which he was an officer, joined B-D. A director of the company, he serves on the finance committee. He is active in education and civic programs in New York City where he lives, and is a member of the Visiting Committee, Sloan School of Management of M.I.T. Congratulations, Marv, may you have continued success.

Best wishes to all classmates for continued health and success.—**Frank T. Hulswit**, Secretary, 77 Temple Rd., Concord, Mass. 01742

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Amiel W. Brinkley, Jr., reports that he is the Assistant Director of Research, Southern Kraft Division of the International Paper Co., in Mobile, Ala. **Martin S. Osman** is currently working on the development of new products at Polaroid Corp. Martin is also interested in sailing as a hobby. . . . **Donald A. Harnsberger** is still in Dusseldorf (since 1967), supplying equipment for the European natural gas transmission system. He is also spending an increasing amount of time in Moscow in connection with oil and gas developments in the U.S.S.R. . . . **Leonard H. Caro** has terminated municipal government consulting practice as of November, 1971 to become City Manager of the City of Wheaton, Ill.

Bill Millen was appointed Chairman of the Liaison Subcommittee of the Chemical Practice Committee of the American Patent Law Association and was also elected President of the Lake Barcroft Swim Club—but otherwise has been out of show business—lately! . . . **Fletcher Bartholomew** left the Boeing Co., in 1970 and joined the Northrop Airport Development Corp. (N.A.D.C.), in Vienna, Va., in August of 1971, after a year at The Center for the Environment and Man, Inc. in Hartford, Conn. He is responsible for all environmental aspects of N.A.D.C.'s

Two Sides of Productivity: Toward a "Silent Revolution" in Steel

The "work ethic" isn't dead, says Richard P. Simmons, '53, new President of Allegheny Ludlum Steel Corp. Prove it? His company has increased production while reducing the number of employees—a trend so strong that it amounts to a "silent revolution," he says.

Mr. Simmons credits Allegheny-Ludlum's success to its recognition that workers are "not willing to help us eliminate their jobs," he told Jack Markowitz, Business Editor of the *Pittsburgh Post-Gazette*, this winter. They want to see evidence that management will increase its own productivity—by implication, with its own tightening of staff—as a quid pro quo for productivity gains on the plant floor.

For example, Mr. Simmons said, his firm's Flat-Rolled Products Division now has 18 per cent fewer salaried people than in the late 1960s but is shipping 20 per cent more steel. Allegheny Ludlum's Research Center in Pittsburgh has been trimmed, but "we are getting more effective research" by devoting most of its work to market applications studies. "You can no longer get a return on investment in new alloys," thinks Mr. Simmons, but he pointed out that stainless steel retractor springs for automobile seat belts became the company's "largest single growth market" in 1972.

Other highlights are reported by Mr. Markowitz following a year-end press conference with Mr. Simmons:

☐ "Last year was the first good year since 1969" for the specialty steels business. Shipments were 850,000 tons, up from 1971's "wretched" 718,000 tons.

☐ The company, which is a subsidiary of Allegheny Ludlum Industries, will spend some $16 million for capital improvements in 1973; of this, $6 million will be for pollution controls.

☐ If catalytic reactors become the favored plan for reducing automobile engine exhaust emissions, a new market for 200,000 to 400,000 tons of stainless steel will be created within three years.

activities. . . . **A. Craig Hood** is currently the Director of Aerospace, International Operations Division Stainland Pressed Steel Co., European Division, in London, England. He is living in Chelsea, London, with wife Loretta and three children . . . **Raymond G. Hawes** has been appointed Director of Manufacturing of Fastener Division, U.S.M. Corp., for their Connecticut, Kentucky, and Pennsylvania plants. He will continue to be headquartered at their Shelton, Conn., plant.

Warren Ponemon has been elected Chairman of the Board for Autonumerics, Inc., manufacturer of numerical controls . . . **Joseph D. D'Annunzio** reports that his firm recently was the low bidder on an $8,600,000 highway construction contract for the New Jersey Parkway Authority. Mr. D'Annunzio is the immediate past president of the North Jersey Branch, American Society of Chemical Engineers, Met Section . . . **Charles C. Park** has been appointed Vice President-sales at the Gleason Works in Rochester, N.Y. He joined that company in 1940 and has held various positions in sales and engineering . . . **Thomas Buchanan** is currently field Sales Manager for Milford Rivet, now a Raybestos Manhattan Co. His wife, Jean Briscoe Buchanan, died on December 8, 1972 after a long, losing bout with a kidney disfunction. His oldest, Brad, is a junior at Cornell in the Civil Engineering Department. Sue, 17, is a high school senior and making a number of applications for college. Ross, 16, is a junior in high school. All are healthy, happy, young people.—**John T. McKenna, Jr.**, 2 Francis Kelley Rd., Bedford, Mass. 01730

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We hope that the Holidays were good to all of you and with the New Year that you are off to greater achievements. A Christmas note from Lois and **Bob Evans** reveals that the Evans family is living in the same house which they occupied six years earlier. In JAPAN! In the December issue, we asked the question and now you have the answer. Bob is doing research on the use of computers to aid in the employment process and his family is again enjoying the culture and beauty of Japan. In nearby Korea, is Lieutenant Colonel **John R. Giancola**. John is assigned as Research and Development Advisor to the Republic of Korea, Ministry of National Defense.

Returning from overseas are **Jack Preschlack** and **Dick Sherwood**. Jack, after five years in Dusseldorf with McKinsey and Co., management consultants, has returned with his family to settle back in the Greater New York area. Dick has returned from three years in Jamaica as Chief Civil Engineer for a $127,000,000 aluminum refinery. . . . Dick left Alcoa and now is in charge of engineering and construction project planning for Johns Manville. The Sherwood's are living in Colorado and enjoy the switch from skin diving to skiing! . . . **Paul Spreiregen** was the keynote speaker for the United States at the First Annual Conference, "Design in the Americas" at Mexico City, this past October 1972. Paul has also been appointed to M.I.T.'s visiting committee on the arts.

Marty Brilliant is still at Bell Labs, in Holmdel, N.J. This past fall, Marty ran for the Township Committee as a Democrat and lost by a landslide, but did "better locally than George McGovern." Right on Marty—better luck the next time around. Whether you win or lose, we agree that it pays to be involved. . . . The happy warrior **Dave Wones** is currently working for the U.S. Geological Survey as Chief, Branch of Experimental Mineralogy and Petrology. The good doctor's research work involves hydrothermal systems and their application to granitic rocks. He is doing geologic mapping in Maine in the summer to keep his hand in, so to speak. Dave attended the Apollo 17 launch as a member of the Lunar Sample Review Board. The epitome of all rock hounds! Dave, and we agree, regrets the end of the Apollo mission now that we are just learning how to best use the system.

Avron Spector has joined the Federal Aviation Administration as a Presidential Interchange Executive. Dave and his family are enjoying Bethesda, Md. Our former Class Secretary, **George Inada**, is also in Bethesda, Avron, as is Fred Bowis, our happy warrior, Dave, and in nearby communities are Warren Davis, Bill Mayhew, Hugh Gallagher, Terry Palmer, and Major Fred Hofmann. . . .**Jim Hazard** is designing a variety of equipment for Scott. In Jim's spare time he is working on restoration of a Delaware Bay oyster dragger built in 1891. Sounds great Jim. The Hazard's oldest daughter Terry is a sophomore in High School, their youngest boy John is in nursery school, and there are "three other darlings in between."

That's all for this month as we have to rush this a little. We'll keep you guessing on our missing classmate questions until next we go to print.—**Dave Howes**, Box 68, Carlisle, Mass., 10741; **Chuck Masison**, 76 Spellman Rd., Westwood, Mass. 02090

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The other day I read a fantastic article about the adventures and life style of **George Taucher.** The clipping from the *Chicago Tribune* was forwarded to me by **Warren Lattof.** It seems that George has retired from the financial rat race to a twelve-room home in the Swiss foothills near Geneva, where he lives with his wife Alice, daughter Kirsten and son Stephen, and practices being a Renaissance man. After receiving his master's degree in business from Northwestern, George worked awhile, then went to the London School of Economics. He then worked for a management consultant firm and arranged a transfer to Europe, where he successfully plied his trade of management reorganization until he decided to make the break and pursue a wider range of interests. From the article, however, the impression is left that George will soon be back in action, attacking some new topic with his customary intensity.

Jackson B. Hester, Jr., was honored recently by the Upjohn Co., as an outstanding contributor to the firm's research and development programs. Dr. Hester, an organic chemist, is a senior scientist with UpJohn's Pharmaceutical Research and Development Division. His current work is in the area of mental diseases research. He recently received the Dr. William E. UpJohn Award from the UpJohn Co., for his work in conceiving and synthesizing unique compounds that have resulted in three drugs currently under study as potential therapy for mental diseases. He resides in Galesburg, Mich. with his wife Judith and their two sons.

A note from **Ed Chandross** says that he's coming out of hiding after 17 years. He got his Ph.D in Chemistry at Harvard and went to Bell Telephone Labs, where he is now doing research in physical chemistry and integrated optics. . . . Last December, **Judson Ball**, his wife Judith, and their two girls moved from Washington, D.C., to a mountain home outside of Denver. From this vantage point he continues his practice of architecture for National Park areas in the Northeast. He calls that a move to the suburbs. . . . Since this column began with a story of a classmate who retired, we'll end it with one who went back to work. **Dell Venarde** is now teaching mathematics at Wilmington College, a small new four-year college. She finds it fun, and she hopes to work also in the library at her children's school. . . . Send along any news of your activities for us to share.—**Allan C. Schell**, Secretary, 19 Wedgemere Ave., Winchester, Mass. 01890

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Remember 5:00 PM on Sunday, June 3, at the Student Center. The Class will hold a Mini-Reunion followed by dinner and an evening at Boston Pops. Any questions, contact **Bill Grinker** at American Used Computer, 15 School St., Boston, 227-8634.

Frank Bader has joined Jelrus Technical Products as General Manager. Frank is also an adjunct lecturer on production management at Dowling College. . . . **Ed Baker** writes that he became a partner of Marshall, Bratter, Greene, Allison and Tucker in New York. He will continue his work in corporate and tax law. . . . **Hugh Bradley** was promoted to Manager of Management and Information Services at Upjohn in 1972. He also participated in the triennial conference of the International Federation of Operational Research, in Dublin, and was reappointed Editor of the journal. . . . **John Coleman's** Christmas letter indicates that he has been working on the hydrofoil *Plainview* which underwent sea trials last fall. During the summer, John and family went on a camping trip from Seattle to Boston and back.

Tom Doherty writes from Toronto that he has entered show business and has done eight major set designs in the past year. . . . **Dick Jacobs** has been named to the Chicago Alumni Fund Council. Dick has published "Managing in a Service Economy," a study of blue and white-collar productivity. . . . **Bob Mansperger** again

sent one of his newsy Christmas letters. Part of the family's busy year included a camping trip through New England last summer. For the rest of the year, Bob continued his work in Warner & Swasey's Research Center. . . . **Carl Slenk** has been named Manager of the Electrical Products Group of the Refractories and Electronic Division of Carborundum. **Rosemarie Wahl Synek** has moved to the University of Texas as an Assistant Professor in the Departments of Microbiology and Zoology. Her husband is a Regional Science Advisor in the Physics Department. **Bruce Wedlock** has been appointed Director Designate of the Lowell Institute. Bruce will supervise a major revamping of the curriculum. Co-secretaries: **Bruce B. Bredehoft**, 3 Knollwood Dr., Dover, Mass. 02030; **Mrs. Lloyd Gilson**, 35 Partridge Rd., Lexington, Mass. 02173

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"If our up-coming Reunion is only half the fun as our Reunion Committee meetings," notes Lou Giordano, "then you're in for the time of your life. **Mark D'Andrea** is the class chowhound and if he has his way there won't be time for anything except eating the entire weekend. We have to keep reminding **Marty O'Donnell** and **Dick Rosenthal** that they are supposed to be compiling a class questionnaire—not a Masters and Johnson study or the Encyclopedia Brittanica. In the meantime, **Skip Fitts** has been scouring the far corners of the universe for a truly unique souvenir of the Reunion. Athletic Chairman **Dick Barone** is still trying to squeeze a three-day bike race, complete with trophies for anyone who finishes, into a two-day weekend. And every once in a while there is a vain plea from our Chairman, **Gary Fallick**, to remember that the days are flying by and that we should really settle down and get serious. It all adds up to fun and surprises. The place: Harbor View at Edgartown on Martha's Vineyard. The date: June 1-3. It will be here before you know it. Will you be there?"

Bernard Schneiderman and his family have recently returned from "two glorious years in Hawaii where I was a field representative from my firm, the Center for Naval Analyses, for each of several navy commands in the Pearl Harbor area. We're now back in the Washington, D.C. area and really miss those marvellous beaches—which do not close on Labor Day." . . . Received a letter from **Richard Glantz** recently and I think you'll enjoy it as much as I did. "After leaving M.I.T., I picked up a master's at Harvard and eventually wound up managing a group at Itek concerned with non-numeric uses of computers, such as automatic typesetting, machine translation, and automated libraries. Then back to M.I.T. for a stab at a doctorate in linguistics. Much to the relief of several classmates, not to mention my parents, I did get married—to a girl who grew up only ten blocks from me in my hometown. Of course we didn't meet until she moved to Harvard Square, principally because when I was entering M.I.T. as a freshman, she was entering fourth grade. In just two and a half short years of marriage, I have succumbed to the suburban stereotype we all used to laugh at in school; mortgaged ranch house in the very correct Lexington community, big station wagon with wood-grained contact paper, cute little toddler with messy diapers, and the agony of a lawn with crabgrass. Technically, I've become interested in making the computer more accessible to the lay public. I've taught a course on technology and society at the Cambridge Center for Adult Education, published on interactive computer systems for personal use, and currently at M.I.T.R.E., am the principal investigator of a project to introduce the computer into patent search procedures into the U.S. Patent Office."—**Michael E. Brose**, Secretary, 30 Dartmouth St., Boston, Mass. 02116

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A recent release from Harvard University announced the appointment to the Faculty of Medicine of **Berny Levy**, (a fellow metallurgist!) as Assistant Clinical Professor of Psychiatry. Berny received his M.D. from Duke University School of Medicine and among his professional positions, he was Associate-Physician-in-Charge of the Psychiatric Liaison Service at Johns Hopkins Hospital, Baltimore, Md., when he taught at the Johns Hopkins School of Medicine. He has been a member of the Committee on Ethics of Human Studies at M.G.H. and is a Coordinator of Medical Student Teaching in the Department of Psychiatry at the hospital.

A short letter from **Bob Muh** states "Earlier this year, my wife Berit and I made the big move to sunny California. Having now lived in Los Angeles for six months, I must admit it would be difficult for us to move back East, especially in Winter. As you may know, Fred Kayne, ('60) and I recently formed a new brokerage firm located here in Los Angeles (Kayne, Muh and Co., Inc., Members of the Pacific Coast Stock Exchange). Fred and I believe very strongly in the need for professional regional firms in Wall Street and are very excited about the future of our firm. Please give my best to any former '59ers in the Boston area."

From the back of the envelopes—**Kent Kresa** writes that he is presently the Deputy Director of Strategic Technology, A.R.P.A. With the exception of a few classmates involved with defense matters, he has lost track of most. He suggests devoting a complete Class Notes section to printing names and addresses. This, however, sounds better suited for a next year's reunion project. We'll work on it, Ken! . . . **Earl Rogers** informs us that, "After a ten-year 'career' in transducer design, including design of all pressure and temperature transducers on Apollo C.S.M. and L.M., I finally got out of the Aerospace business. Now I am General Manager of the Life Systems Division of Bournes, Inc. We make respiratory therapy and monitoring equipment, including a special infant respirator for treating Hyaline Membrane disease in premature infants." . . . **Bob Jenkins** writes, "I have left my job at the University of Illinois to go into full-time private practice psychotherapy. I am completing my two-volume statistics text and am about to start writing a book on psychotherapy technique, with my wife. Barbara is a part-time Professor at Governors State University and in private practice with me."

Oliver Seikel is presently Legal Manager, International Operations, Midland-Ross Corp., involved in the negotiation of foreign licensing and joint ventures, with related travel to Europe and South America. . . . A recent press clipping announced the certification of **Rafael Deutschmann** by the State Board of Registration of Architects as a Registered Architect in this Commonwealth. A former staff member of the Boston Redevelopment Authority, he is currently employed by Edward J. Tedeseo Associates, Inc., of Winchester. Rafael resides in Belmont with his wife, the former Anne Marie Ferrick, and their four children. . . . A Classmate of ours had an important project associated with the recent Apollo 17 mission to the moon. **Shel Buck** was a Technical Director of traverse gravimeter experiment for Draper Lab and was at mission control in Houston, Texas during the three surface excursions of the Apollo 17 astronauts. The Draper Lab gravimeter was the first and only piece of hardware made at M.I.T. to reach the lunar surface during the Apollo program.

Dick Collens writes that he is now Assistant Professor of Medicine at Albert Einstein College of Medicine and at this moment enjoying academic medicine despite the politics involved. He has met many Tech graduates coming up through the ranks of medical students. . . . **Brad Bates** informs us that he is "now with Scientific Research Staff at Ford Motor Co. (after a brief interval of being a "statistic" in the Phase II economy squeeze). Hated to leave New England but finding Ann Arbor a nice place to live, and taxes are certainly lower! P.S. M.I.T. Placement Office does a great job!" . . . **Jim Snodgrass** was recently named Vice President, Systems and Consulting, of Glove Decision Service, Inc., a subsidiary of Swift and Co., offering information services to Swift and Co. as well as outside firms. . . . **Mike Haugh** as been teaching for the past four years in the Chemistry Department at Temple University. Received Ph.D. in Chemistry from U.C.L.A. in 1969. He worked five years as a Chemical Engineer in New Orleans and Los Angeles before starting graduate work. Mike was married in 1963 and has one daughter, 9 years old.

Bud Haselton dropped me a short note saying "Dear Art, I enjoyed our conversation a few weeks ago even though the primary subject was my forthcoming Alumni Fund contribution. *Mirabile dictu*, (Random House defines as either 'marvelous to relate' or 'strange to say'—take your pick, I'm still working for Boeing here in Seattle, a fact which demonstrates the almost limitless applications of blind luck. I'm also seven years married and have two offspring." . . . **Steve Samuels** spent his sabbatical leave last year from Purdue University at the Weiz-

mann Institute of Science in Israel. . . . **Lloyd Howells**, our 15th Reunion Chairman, is spearheading plans for a mini-reunion to be held in conjunction with Alumni Day this coming June at the Institute. This would not only provide an opportunity to enjoy the Boston Pops and an International Buffet with classmates, but would provide a chance to relax, renew acquaintances and imbibe a few with old friends. You will be hearing more about our mini-reunion in future Class Notes and from Lloyd directly.

One final and sad note again this month. It is with deep regret that I relay to you the news of the untimely death of one of our classmates, **John Jackson**. John was active in both music and chemistry. In addition to his M.I.T. degree, he had a bachelor's degree in music from Oberlin College and a doctoral degree in physical chemistry from the University of Colorado. At the time of his death, he was an Assistant Professor of Chemistry at the University of Maryland. The author of many articles on the crystallinity of polymers, he was also a poet, having received the Boit Creative Writing award at M.I.T. for his poetry. On behalf of the entire Class, may I extend our deepest sympathy to his widow, his family, and friends.

That's all for this issue, see you next month.—**Arthur J. Collias**, Secretary, 61 Highland Rd., Brookline, Mass. 02146

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Your volunteer columnist of the month is **Bruce Layton**. That gives me the privilege of telling you about myself first. I'm still a Captain in the Air Force, now assigned to L. G. Hanscom Field, Concord, Mass., after a year's tour in scenic Saigon. I'm actually working at the MITRE plant, where U.S.A.F. leases office space, as a reliability/maintainability engineer. (Six munce ago I cut'nt even spel manetaneabillity injunere, an now I are one!) If anyone is moved to get in touch, my new address is 16 Westgate Dr., Apt. 106, Woburn, Mass. 01801 (phone 935-0944). In the process of volunteering to write a column, I learned that our Class Secretary hasn't written anything recently but a dissertation. That's better than my recent experience, which is that since returning to the Land of the Bean and the Cod, I seem to have been writing nothing but checks.

As this column was composed in October, 1972, the news is somewhat old. The largest single contribution in the mail pouch Linda sent me is a paper by D. B. Botkin, **James F. Janak**, and J. R. Wallis, titled "Rationale, Limitations, and Assumptions of a Northeastern Forest Growth Simulator" which appeared in an I.B.M. Journal. The abstract follows: "A cooperative agreement between Yale University and the 1970 summer program of the I.B.M. Research Division resulted in a flexible computer program to simulate the growth of the uneven-aged, mixed-species stands of trees on the 10-meter by 10-meter experimental plots of the Hubbard Brook Ecosystem Study."

Dr. Janak received his S.B., S.M., and Sc.D. from M.I.T. in 1960, 1962, and 1964 respectively, was an Associate Professor in Electrical Engineering at M.I.T. and a Ford Foundation postdoctoral fellow from 1964 to 1965, when he joined I.B.M. at the Thomas J. Watson Research Center in Yorktown Heights, N.Y., where he is a member of the theoretical physics group and has worked on a variety of problems in solid state physics. He is a member of the American Physical Society, American Association for the Advancement of Science, Tau Beta Pi, and Eta Kappa Nu.

Promotions: M.I.T.'s list of July 1, 1972 faculty promotions included that of **Roger G. Mark** to Associate Professor in the Department of Electrical Engineering. . . . Air Products and Chemicals, Inc., Allentown, Pa., announced (May 9) the appointment of **Richard H. Oeler** as Manager of Wastewater Treatment Systems in their Cryogenic Systems Division. He had been Marketing Manager, and before that Assistant Sales Manager for the On-Site Plant Department. . . . I.T.T. Rayonier Inc., N.Y., announces (May 1) the appointment of **John O. Hartung** as Executive Assistant to the President. He had been Manager of Business Planning. The only other item is a clipping from a brochure from R. Dixon Speas, '40, Associates, naming **Douglas L. Bashioum** as a member of their senior staff. . . . Major **Robert E. DeMichaels** became Chief of the Records Processing Branch, a staff office of the Dean of Faculty at the Air Force Academy. He writes, "Have enjoyed matching wits with our B3500 computer and hope to remain here another year or two." . . . **Vernon T. Yoshioka** has been elected Moderator (similar to president) of the San Diego Association of the United Church of Christ, for one year from February 1972. He has also taken up barbershop quartet singing by joining the Southern California Music Masters of El Cajon, S.P.E.B.S.Q.S.A., Inc. . . . **R. M. Davidson** is President of R.A.D.M.A.R. (Research and Development Marketing), Inc.

Robert B. McCullough, of Milpitas, Calif., is Systems Manager at Advanced Memory Systems, Sunnyvale, Calif., in charge of developing a line of semiconductor add-on memories to I.B.M. 360 and 370 computer systems. . . . **Ronald L. Berry** is Chief of Mission Design, N.A.S.A. Manned Spacecraft Center, and was expecting his third child by the end of June. I hope congratulations are in order by now; ditto for Bernice and **Stephen B. Russell**, who live in Lexington with their one-year old son, Scott Eric, and were expecting in early September. . . . **Joel M. Winett**, of Framingham, Mass., is the proud father of his third daughter, born March 27, 1972. . . . **Richard Jay Bertman** writes that he is practicing architecture in Boston with another classmate, **Maurice Childs**. The name of the firm is Childs, Bertman, Tseckares Associates Inc., at 306 Dartmouth Street. . . . **Bob Gottlieb** writes from Shawnee Mission, Kan., "Am spending my time consulting in the aerospace world in Huntsville, Ala., and assuming responsibilities of my new position as Vice President of Lewis Industries here in Kansas City. We're proud new owners of a house and a horse; and if ever I could finish up my doctoral thesis (University of Texas), life would be perfect!" . . . **James T. Cobb, Jr.**, writes, "Finally own my own home, after years as a renter. Teaching kinetics, reactor design, polymerization engineering. Advise two Ph.D. candidates and five Master's candidates. Will be teaching for six weeks in Chile this summer. Research in bioengineering sponsored by Gulf Oil Chemical Co. Member of Continuing Education Committee of AIChE. Just elected as Treasurer of local section of AIChE."

Sidney L. Ossakow left Lockheed Research Labs, Palo Alto, Calif. in March 1971 to take a position as Research Physicist in the Plasma Physics Division of the Naval Research Lab in Washington, D.C. The Ossakows had their second son, William Benjamin, on January 30, 1972. Mrs. **Larry Brock** writes from Collinsville, Ct., that "Larry's still in the aerospace industry trying to sell the beleaguered airlines some more hardware. Good news! Our two sons have a new sister, Sharon Elisabeth, born September 16, 1971." . . . **Edward A. Patrick** notes that he is Chairman of the Fund in the Lafayette, Ind., area. . . . That exhausts the mail pouch. Please send all Class Notes and offers to write a column to—**Linda G. Sprague**, Secretary, 1004 Cathcart Way, Stanford, Calif. 94305

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Mr. **Warren McCandless** has been promoted to Vice President of Manufacturing of Free-Flow Packaging Corp., in Redwood City, Calif. . . . **David S. Stare** tells us that he is now in the wine business in California having formed Dry Creek Vineyard, Inc. This is California's newest premium quality winery. In the fall of 1972, about 2,000 cases were produced. The new winery will be completed in mid-1973 in Northern Sonoma County, one hour north of the San Francisco Bay Area. Any alumna will be welcome at any time to try the wines at the winery. We thank Dave for the invitation. **Tom J. Alexander** received his M.B.A. from Stanford University in June, 1970, and was also married to Joanne Jirous of Seattle, Wash. We extend our congratulations on both accomplishments. He joined Macro Systems, Inc. as Management Consultant. He left Macro in October and became a Special Assistant for Financial Planning to the Vice President of Transportation and Instrumentation Sciences Divisions of E.N.S.C.O., Inc., an applied research Firm in Washington, D.C.—**Gerald L. Katell**, Secretary, 122 N. Maple Dr., Beverly Hills, Calif.

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This issue has brought forth one Class Hero who wrote about his activities. **Steve Glassman** writes that he is thoroughly enjoying his bachelorhood in New York City. He spends his days in court (as an attorney), his evenings on the town, and his winter weekends skiing in Vermont. . . . The other Class Hero is **Geri Sample Grube**, who is finishing her Ph.D. in theoretical physics at North Carolina State. She was remarried last

August to Arthur Grube of British Columbia, who is also a Ph.D. candidate at North Carolina State. Geri is working with the M.I.T. Educational Council in the area. . . . **Peter Angevine** and his wife Rosalind are living in Connecticut and have one daughter named Sharon. . . . **Ned Block** is an Assistant Professor of Philosophy at M.I.T. Ned notes that Leland Henberg is studying city planning at Berkeley, and that **John W. Miller** is first chair bassoonist at the Minneapolis Symphony Orchestra. . . . **Daniel Flamm** received his Sc.D. in Chemical Engineering in 1970, while his wife completed her Ph.D. in Psychology in 1971. They are both assistant professors at Texas A. and M. University and have two sons, ages 6 and 3. . . . **David Hoover** is Vice President and a partner of John Brown Associates, a community planning and development firm in Boston. . . . **Ronald Lawson** and his wife Jane are both working for MITRE Corp., in England.

John Ludutsky and his wife Louise have been traveling of late to such places as Moscow, Amsterdam, and Tanzania. John is Assistant General Manager of the Industrial Systems Division of Industrial Nucleonics Corp. . . . **Kenneth Kaiser** is a visiting lecturer at M.I.T. this year. . . . **Douglas McCallum** is on leave of absence from the University of Glasgow while he and his wife are in Bogota, Columbia, as part of a United Nations World Bank study on urban development. . . . **Leonard Parsons** is Chairman of the Department of Business Administration in Claremont, Calif., and has published two articles recently in the Journal of Marketing Research.

David Patterson, his wife Sue, and their two daughters recently returned from Chile where David was an economic/commercial officer in the U.S. Embassy there. They are now in Arlington, Va., where David is studying Persian for a new assignment in Iran. . . . **Maury Shulman** and his wife Rena have purchased a house and are now in the process of furnishing it. . . . **Edward Wolcott** is Quality Control Manager for Gates Energy Products, a battery-making subsidiary of Gates Rubber Co. That's the news. Let me hear from you.—**Ron Gilman**, Secretary, 5209 Peg Lane, Memphis, Tenn. 38117

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No column in January, a large one in February, and now back to our usual mini-notes, which was fortunate as the Alumni Office gave me three days notice to get this edition written and submitted. Mostly job news this month. I guess it's the off season for weddings, births, and graduations.

Dave Rubin reports that he has successfully located a new airport for the Twin Cities and is now going to work for the Maryland Department of Transportation, planning the Maryland airport system. Dave's wife Sharon, completed her Ph.D. at Minnesota in December and is seeking employment in the Washington-Baltimore area. . . . **John Butler** moved to Pittsburgh in February of 1972 to work for Calgon. John is playing rugby with Pittsburgh R.F.C. and enjoying the "city" after five years in Midland, Mich. John is still unmarried by virtue of fancy footwork. . . . **Charlie Rall** moved to Bell Labs in Murray Hill, N.J., due to the closing of Bellcomm in Washington, D.C.

Martin Goldsmith will be joining the staff of New England Medical Center Hospitals in July. The Goldsmiths are hoping to buy a home in Needham soon. . . . **Mike Weiss** received his M.B.A. from the University of Chicago in December of 1971. In July of 1972 he started work as a metallurgist for the Midwest Region of N.L. Industries. Mike is still single and enjoying Chicago. He inquires about the whereabouts of **Herb Trachtenberg**. . . . **Ron Newbower** received his Ph.D. in Applied Physics from Harvard two years ago. He is now applying it to the development of medical instrumentation and measurement methods as both the Deputy Chief of Bioengineering at Massachusetts General Hospital and an Associate at the Harvard Medical School. Ron and his wife, the former Donna Denekamp, are moving to Acton soon.

Steve Rosenberg has left his position as Commander of the Planning and Research Division of the Boston Police Department to become Vice-President of Ogden Security Inc., a new subsidiary of Ogden Corp. . . . **Howie Ellis** is President of Enviroplan, Inc., an environmental consulting company doing evaluations for government, industry, and conservation groups. He is also an Adjunct Assistant Professor at Baruch College in the City University of New York, teaching a course in Decision Analysis. . . . **Harry** and **Barbara Vickers** are still in the Boston area—Harry with Entrex, a computer company in Burlington, and Barbara an editor for math textbooks for Houghton Mifflin. . . . **Chris Ebbe** is enjoying living in Madrid and traveling around Spain and the rest of Europe. Chris is a clinical psychologist at an Air Force base hospital, doing group and marital therapy. He also trains volunteers for a telephone crisis line and provides ongoing training for school counselors.

Khee Chng has been appointed Senior Scientist at G.C.A. Corp., in Bedford, Mass. . . . **Jeff Karas** left Hughes Aircraft last May and now works with computers for Honeywell. Jeff and Regina are the proud parents of their first child, a son, Jaime Eliezer, Born November 19. . . . Fran and **Steve Grodzinsky** have a second child, Mark, born December 7, 1972. . . . Adrienne and **John Beckmann** vacationed last summer in Europe—first vacation since the birth of daughter Debbie in 1969. . . . The Beckmanns report that **Ken Ross** has started his own firm in California.

That is our hasty March-April column. The Boston winter has been mild this far, but I'm not fooled. Wait for February. —**Steve Lipner**, Secretary, 3703 Stearns Hill Rd., Waltham, Mass. 02154

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Law finals again. Writing these notes is a welcome change from studying my evidence and income tax books, which are not exactly best sellers.

Kevin Kinsella is a staff member in Mexico City with the Latin American Teaching Fellowships program. He arranges placements in Mexican universities for their teaching fellows and raises money in the business community. They are looking for Spanish or Portuguese speaking Ph.D.'s in hard science, engineering, business, and economics, who would like to teach for two years in Latin America. Kevin likes Mexico City except for the air pollution. After two years in the Middle East and Sweden, he wrote technical articles for Adage, a computer graphics company in Boston. . . . **John Rudy** writes that on November 27, Jan delivered their first baby, Brett Daniel. "I thought that running back and forth from the hospital was work, but that's nothing compared to 2 a.m. feedings." . . . They received a call from Elaine and **Joel Shwimer** in Paris. . . . Lees and **Stephen Stuntz** are kept busy by their child Laurance, and house repairs. They are expecting a second child in June. Stephen is still with Teradyne; he recently moved from manufacturing into accounting. Lees has been writing both her master's thesis and a novel.

Penny and **John Halberstadt** write: "For the first even-numbered year in our married life, there have been no additions to our family." John Jr. 6, Ellie 4, and Drew 2, keep them plenty busy. . . . I received a card from Manda and **Bill Jeffrey**. They are living in Orono, Maine, while Jeff works on his M.S.E.E. . . . We received a report from **Ron Norelli** that he has accepted a position with Gillette in Boston; the group he works with is searching for and developing new products outside of Gillette's traditional line. He also is in the second year of the evening M.B.A. program at Northeastern. Ron's wife Nancy, Wellesley '72, is working at Wellesley as Assistant Director of the Washington Intern Program. She spent the summer of 1971 as an intern in Senator Birch Bayh's office.

Ron Norelli also reports some very sad news: "Another member of our Class and a fraternity brother of mine, **Jim Ward**, died very suddenly in Paris on September 19. He had been working for Burroughs for some time in Paris. I believe the cause of death was an aneurysm. Jim majored in math and was a native of this area." Our sympathy goes to his loved ones.

Charles Heiberg has been appointed Assistant Professor of Mathematics at Virginia Wesleyan College in Norfolk. He previously received a graduate degree from and taught at Ohio State University. He is married to Karen Makela of Lowell, Mass. They have two children. . . . **James Fletcher** has been elected a George F. Baker Scholar at Harvard Business School. He will graduate in June. . . . **Dick Boulay** is a graduate research assistant at the University of Arizona, flying sailplanes around in a program to get data on mountain waves. He expects to get his M.S. in Aerospace Engineering by May. . . . **John Toivonen** is still doing research in molecular biology at U.C.L.A. . . . **Greg Wight** recently ended his long illustrious Air Force career and accepted an engineering position with the Con-

necticut Department of Environmental Protection. He, Tammy, and Katy have moved to Hartford where Greg can embark on a career of helping mankind.

Jim Kirtley is an Assistant Professor of Electrical Engineering at M.I.T. James V., their second, arrived in May. . . . **Alan Wolff** married Rosemary Hughes last May. They live in Boston, and Alan works for Arthur Andersen and Co. . . . **John Foss** is a student at Harvard Graduate School of Education. . . . **Markus Zahn** spent the summer working at the National Bureau of Standards. . . . **Mark Lembersky** is an Assistant Professor in the Department of Statistics at Oregon State University. He completed Stanford's Ph.D. program in 1971.—**Jim Swanson**, Secretary, 508 Thompson, Mountain View, Calif. 94040

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Hello again. The Washington area is now in the process of recovering from a double hangover—the inauguration and the superbowl. A pleasant surprise about the inauguration was a half-day holiday for government employees the day before, which was only announced at the last minute. On another topic, our backlog has diminished to zero, so start sending those cards and letters folks!

Jerry Grochow, currently in a doctoral program at the Sloan School, recently delivered the lead-off talk at a conference sponsored by the National Association of Concerned Business Students called "Corporate Social Reform in a Dynamic Society." The symposium was held at the University of California at Berkeley and about 180 participants from business schools, corporations, activist organizations, and the press attended. In speaking on "Corporate Social Reform: A Young Person's Viewpoint", Jerry stressed that today's youth do not see themselves so much as "students" or even "young people" as they think of themselves as consumers, potential employees, potential shareholders, potential managers, and as the public. He summed up his hopes and suggestions with the plea for "making the corporate person humane." . . . Back at M.I.T. after a tour in the navy, **Ken Theriault** writes, "Nice to be back but I'm sure glad I took a break for four years. I couldn't have stood this place more than five years straight." . . . We also heard from two classmates who are still in the navy. **Jack Zeigler** reports that he received a doctorate from U.C.L.A. in June 1971 with a thesis on nodal blocking in computer networks (such as the ARPANET). Since he had such a good knowledge of electronics, the navy made him N.T.D.S. (Naval Tactical Data System) Maintenance Officer on the U.S.S. *Gridley* (D.L.G.-21) for one and a half years. He earned six months combat pay—Jack doesn't mention if there was any combat—during a western Pacific deployment. He is now an instructor in computer science at the Naval Postgraduate School in Monterey, Calif. . . . **Steve Reimers** has returned to Washington, D.C., after completing a five month job for the navy in Hawaii as Equipment Readiness Manager on the Navy-Makai Range Dive, an operation similar to the Sealabs. He was promoted to Lieutenant, U.S.N.R. last April and is still in his old job as Project Officer at the Navy Experimental Diving Unit.

We have three notes from people who are involved in the *exotica* of high finance. First, **Pete Amstutz** says that he is working on Wall Street as a security analyst and recently began to cover the electrical equipment industry. This means travel to such exciting places as Chicago, Cleveland, and Mansfield, Ohio. In his spare time he is studying to become a chartered financial analyst and says he still enjoys New York. . . . After graduation, **John Hrones** went to the University of Michigan where he got a master's in Computer and Communications Sciences. He then worked at the Draper Lab for a while, but last fall he left to pursue one of his hobbies professionally by becoming a commodity specialist for Hayden, Stone, Inc., in Chestnut Hill. . . . Both **Ken Morse** and his wife Joan work in New York, commuting from Brooklyn Heights. After spending a summer consulting to a French firm on the sale of grain to the Peoples Republic of China, he became Assistant to the President of Schroders, an international merchant bank with headquarters in London and New York. . . . From the Illinois prairie, **Richard Parker** reports that his family is thriving. Richard and Beedy are the proud parents of a new daughter, Eleanor Elizabeth, who was born on May 19, three months before her father finished his Ph.D. thesis in Economics from Boston College. . . . In the academic world we have word of three faculty appointments: **Thomas Romer** joined the Economics Department at the University of Western Ontario in London, Canada while **Tim Johnson** is on the faculty of old Course VI at our beloved 'tute.

George Piccagli has been appointed an Instructor in the Department of Sociology at the Illinois Institute of Technology. . . . Two years ago **Nathan Curland** received a doctorate in Electrical Engineering from the University of Minnesota. He is working for Microbit, a small computer memory company on Route 128. He would enjoy hearing from old acquaintances at 56 Halcyon Rd., Newton Mass. . . . **Richard Handler** reports that he is glad to be back East after four years and an M.D. degree from Stanford. He is working as a straight medicine intern at Albany Medical Center Hospital. His wife, Leslie, received an M.A. from Stanford and is teaching art in Scotia, N.Y. He adds that **Tom Chester** and **Jesse Mantel** will be graduating from Stanford Med in June.

See you next month.—**Gail** and **Mike Marcus**, Class Secretaries, 2207 Reddfield Dr., Falls Church, Va. 22043

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Since I have missed the last couple of issues and have received a large number of letters and notes, I will jump right into my mail bag without the usual "introductory" paragraph. **Robert Woerner** writes that his assignment with the Air Force at Westover was only for three months during last summer. He is now completely free of the Air Force and is back at M.I.T. where he is trying to finish his Ph.D. thesis in Physics within the next year. . . . After picking up his S.B. and S.M. degrees in Electrical Engineering in June 1970, **Alan Kraning** joined the Analytical Studies Group in the Office of the President and Chancellor at M.I.T. Al is currently engaged in several projects with the group, the largest being the design and development of a time-shared information system which will aid academic departments in planning and implementing new educational programs. Al reports that M.I.T., like most universities, is feeling the continuing crunch caused by soaring costs and the prospects for decreasing revenues (have you given to the Alumni Fund?) He is also working with Professor Dan Nyhart in his efforts to develop law related studies at M.I.T. In this connection, he plans to attend law school this fall. Al provided some information on fellow classmates as follows—**Joe Steuert** and his wife Barbara, a Wellesley graduate, are the proud parents of a daughter Betsy. Joe works for E. F. Hutton in New York City after having earned S.B. and S.M. degrees in physics and an S.M. in Management from the 'tute. . . . **Dan Dudgeon** is currently working on his doctoral thesis at Lincoln Labs in the Electrical Engineering department. . . . **Greg Madera** is a third-year law student at Harvard Law School. . . . **Art Beals** is now at M.I.T. as Assistant Director of Housing and Dining. . . . **Doug Limbert** is working on his doctorate in Mechanical Engineering at M.I.T.

Gavin Drake Clowe received his master's from Rutgers on June 1, 1972. . . . **Ka-Hung Fogg** is doing research on small-scale galactic structures under Professor S.C. Simonson, '60, at the University of Maryland. . . . **Alan S. Ratner** is "advancing the frontiers of plasma physics at Yale." . . . **Michael Laird** joined Cammins Engine Co., in Columbus, Ind., after completing the Sloan School master's program in May 1972. He and his wife Robyn live in Brown County just one block from the only stop light in the county. His current job involves tasks as Management Planner and Business Simulation Specialist. . . . **John R. Smith** is still working for Hughes Aircraft. He has completed course requirements for his M.S.E.E. at U.S.C. and is planning to attend California State-Fullerton for an M.B.A. His plans for this past winter included ski trips, Hawaii, and desert camping and hiking. . . . **Donald B. Carlin** is a graduate student in the Engineering and Applied Sciences department at Yale doing his Ph.D. thesis in laser physics. . . . **Gary B. Hirsch** and his wife Linda became parents of a son named Adam on August 10, 1972. Gary is still employed with the Cambridge consulting firm of Pugh-Roberts Assoc., Inc. His work is primarily in the area of health care policy and planning. . . . **John Loewenstein** is graduating from medical school this spring and plans a career in ophthalmology. He and his wife Louise now have a one-year-old son named Josh and are expecting a second child in the spring. . . . **Peter Georgi** was in Europe

this winter for a training course to become a teacher of transcendental meditation. He spent last summer at a training course sponsored by the U.S. Department of Health, Education, and Welfare to become a teacher of the science of creative intelligence, the theoretical counterpart of transcendental meditation.

Joseph Horton finished medical school on February 21, 1973. After a one month trip to Europe, Joe plans to become a pediatrician or a radiologist. . . . **Stephen Lee Weinberg** is continuing to enjoy the "ruggedness and beauty(ies) of California." He has finished his "Sinfonia" and has received his M.A. in Physics. Steve adds that he can still be found at Berkeley. . . . **Joseph B. Lassiter** has been promoted to Assistant Professor from Instructor in M.I.T.'s Department of Ocean Engineering. His appointment was effective as of September 1, 1972. . . . After receiving his M.S. in Physics from Rutgers on June 1, 1972, **Hans W. Polzer** was drafted, enlisted in Army O.C.S., received his commission in the signal corps, and attended signal officer basic course and the army data processing officer course. He is now in airborne school and is assigned to Stuttgart, West Germany. . . . **Steven Rothman** bought a house in Stow, Mass., last winter. His "family" has grown to two Collie puppies and one Siamese cat. He is still employed by D.E.C. in Maynard. . . . **Roger Chang** and his wife Lulu had a son Daniel, born on June 28, 1972. The army has assigned him to Arizona where his commanding officer has given him time to work on his doctorate at the University of Arizona to develop solar energy.

Steve Callis is "living a life of utter dissipation and degradation in a squalid Detroit slum in pursuit of a writing career" hoping "to become the H. P. Lovecraft of pornographic literature." . . . **George Varga** graduated in June 1972 with his M.B.A. from Harvard. Just prior to graduation, George married the former Beverly Skotnicki at the Harvard Chapel. He is now working as an Assistant to the President for Island Gem Enterprises, a real-estate development firm located on the island of St. Maarten in the Caribbean. . . . **Donald Collins** completed Duke medical school this past winter and planned to enter family medicine. He was in London for a month last summer studying the National Health Service and then spent two months on a cardiology clerkship in Los Angeles. . . . **Thomas Stewart** has been at U.C.L.A. since graduation working on his Ph.D. Tom reports he is having a ball, rock and mountain climbing in the Sierra Nevada mountains and surrounding areas when he is not studying or working as a Teaching Assistant at U.C.L.A. . . . **Robert G. McGregor** is an army engineering officer in Europe monitoring two construction battalions in regard to all ongoing construction efforts. His tasks include lining up new jobs, laying down requirements for survey work, soil analysis, manpower, machinery, and funding. Bob says it is "an interesting position and has taught me a great deal about earthwork and building construction." . . . **Gary K. Montress** is still in graduate school at M.I.T. He was appointed to the position of Instructor within the Electrical Engineering department in June 1972. His current studies are in the area of solid state microwave devices. . . . After graduation, **R.H. Parker** spent one year at Cornell University and received his master's degree in June 1970. He then worked with Rand Corp., in Santa Monica, Calif., in their computer science division until July 1972. Currently, he is a staff researcher at the newly formed U.S.C. Information Science Institute in Marina Del Rey, Calif.

James Sicilian is still plugging away towards his Ph.D. in Nuclear Engineering at Stanford with hopes of completing the program in June 1973. He is also working part-time on contract programming the Illiac IV at the Ames Research Center. . . . **Richard W. Dorman** now holds the title of Manager—system product development at Pan Am with worldwide responsibility for further development and expansion of PanAm's World Rent-a-Car. . . . **Allen Simon** is working towards a joint master's degree in City Planning and Civil Engineering at the University of Pennsylvania. . . . One of his classmates is George Claflen who is working towards his master's in City Planning and Urban Design. . . . **Jeff Weissman** is in his second year at N.Y.U. Law School and still has his Root-Tilden Scholarship. He has "played some intramural football which gave me a chance to kick and punt (fun for an old soccer player)." His wife Linda has entered a master's program in occupational therapy at N.Y.U. . . . **James P. Kornberg** is presently on a leave of absence from the three-year Dartmouth medical school program to complete his Sc.D. at Harvard in Environmental Science. His thesis is on the subject of high temperature filtration.

Eric R. Wolf will attend the University of Pennsylvania school of medicine beginning in September 1973. . . . After graduation, **Theodore R. Crowley** worked at the M.I.T. Instrumentation Labs on the Apollo program until the N.A.S.A. layoffs the following spring. He then got married, had a couple of odd jobs in computers in New Jersey, and joined the Air Force. After three months in O.T.S., Ted received his commission in May 1971. After a year at pilot school, he received his wings on June 1, 1972. He spent two months in Oklahoma at an upgrade school for the C-141 transport and finally came back to civilization at his present assignment at McGuire A.F.B. in New Jersey. . . . **Willard J. Basner, Jr.**, completed his M.S. in Aero-Engineering at the University of Michigan in 1970. He taught high school mathematics for two years before taking on his present employment as a Mechanical Design Engineer at the General Electric aircraft engine group in Lynn, Mass. . . . **Brazos V. Guido** has been working for his father and is now managing Guido Lumber Co. in San Antonio, Texas. He has married the former Kathleen Herr of Buskirk, N.Y., whom he met while a student at M.I.T. She has transferred from the Boston Conservatory of Music to Trinity University in San Antonio.

Tom Thomas graduated from the University of Missouri Law School in December, 1972 and has gone into private practice in Rolla, Missouri. While an editor of the *Missouri Law Review* during the past year, he received an award for the best student article in the review. . . . **Henry I. Levine** married the former Risa E. Perlman on June 18, 1972. Risa is an art teacher in the New York City public school system. Henry is working towards his M.D. degree at S.U.N.Y.-Downstate Medical Center where he is a member of the third-year class. He currently anticipates a career in psychiatry and community medicine despite a recent setback in the form of a slipped disc. . . . As President of our Class since 1965, **Mark Mathis** needs no special introduction in this column. Mark graduated from the University of Pennsylvania Law School in May 1972 after deciding not to continue in a joint J.D.-Ph.D. program in public policy analysis. He has passed the District of Columbia bar exam and is now associated with a law firm there. . . . Keep those letters and notes coming in!—**Richard J. Moen**, Secretary-Treasurer, W-1781 First National Bank Building, St. Paul, Minn. 55101

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A pleasant spring to all.

Alan Davis starts off the column this month with an interesting note received by your editors. Alan became fully certified with the I.S.I.A. as a ski instructor last winter, after having spent the last three winters as a ski instructor in Park City, Utah. In addition to that, he acquired his Ph.D. in Computer Science from the University of Utah and is presently a Professor of Computer Science at the University of Waterloo in Ontario. . . . **David Thiel** writes that he is involved in the programming of large automatic test systems for General Radio in Concord. . . . Computers are also involved in **Linda Lippitt**'s work in M.I.T.'s Mechanical Engineering department. Besides developing the new computer facility there, Linda devoted much of her time to her March 17 wedding to Edward Furrow, '71. . . . Speaking of marriages, **David Saar** married the former Betty Brodsky, B.U. '72, on December 17 of the last year.

Richard Hood is currently employed by Western Electric as a Planning Engineer in their Greensboro, N.C., Defense Activities Division. . . . Our Class is represented in the banking industry by **Robert Wilk**. He is a security analyst in the Trust Department of Mellon Bank, concentrating on the office equipment industry. Evidently, "alive and well," Robert likes working and living in Pittsburgh.

Clifford Smith writes that he is a "currently contented, middle-class, suburban homeowner." He is employed by General Electric in Lynn as a systems analysis engineer for their Aircraft Engine Group. A new member of the family arrived in October—Christopher. . . . An open invitation to visit has been extended by **Howard Hoffman** and his wife, Janet Healy Hoffman, Stanford '71, at their home near San Francisco in Mountain View. Howard is working for Metcalf and Eddy, a consulting engineering firm, after

procuring a M.S. in Environmental Engineering from Stanford. . . . Finally got a word or two from **Robert Powell.** Rob is pursuing water-pollution control for Esso Research and Engineering, after receiving his M.S. in Chemical Engineering from Penn State.

Now the column turns to classmates who are pursuing higher-education opportunities. **Louis Edelson** is a first-year medical student at Stanford. Also in med school is **Kenneth Labresh** who is a junior at the University of Minnesota. Evidently, he is also doing some Electrical Engineering graduate work there too. Kenneth was married in June and writes that he now has a wife, Carol, and a ten-year old son, Jim. He has also been involved in work on drug-abuse programs and spent last summer working for the Governor's office. . . . **Jim Bricker** has an important tidbit to add to the news about him—planned marriage to Amy Michelman, Simmons, '73, in July. . . . After finishing an M.S. in Computer Science at Princeton, **Kenneth Sills** is pursuing an M.S. in Industrial Administration at Carnegie-Mellon. It should be completed by summer and job hunting in New England then becomes a reality.

Got a little news-clipping stating that **Chee Yee Chong** received honorable mention from the American Automatic Control Council at a conference for a joint paper on stochastic control of linear systems. He is a doctoral student at M.I.T. . . . Now a little goodie from **Karen** and **Gregory Arenson** was received by me in the mail. Karen has received her master's degree in Public Policy from Harvard and spent last summer working for the *Miami Herald.* She made it onto the floor of the Democratic Convention one night also. In September, they went to Japan for several weeks to vacation. Gregory spends much of his time at his law studies at the University of Chicago, while Karen puts out her corporate social policy newsletter twice every month for the non-profit, educational organization, National Affiliation of Concerned Business Students. Karen writes that she and Greg miss their old friends and the easy companionship of the Boston area.

Just a short note about your editors. Robert has had an article that he co-authored with another M.I.T. student, Lawrence Prier, '71, published in the December 1972 issue of the *Magazine of Bank Administration*, entitled "An Approach to Bank Profit Center Reporting and Control." Classmates, it is not mandatory reading.—**Robert Vegeler**, 800 N. Smith Rd., Apt. 7W, Bloomington, Ind. 47401; **Laura Malin**, Secretary, 406 Beacon St., Apt. 1, Boston, Mass. 02215

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Score another error for your faithful Class Secretary, and this is a real prize. I should have reported in December that Dan Witschey married Barbara Schwarze. **Barbara K. Swartz** (better known as Kathy) wrote to correct me and tell me that she is still single and was, at the least, surprised to find that I had married her off. My apologies to all involved. One happy effect of this was a long news-filled letter from Kathy. She is now a grad student at the University of Wisconsin working in health economics, after a stint at H.E.W. . . . Kathy also reports that **Paula Stone** is still around the Institute this year, working on a Master's from C.E. . . . **Betty Hutchins** was a management intern at WTOP, the C.B.S. affiliate in Washington until February when she went to San Francisco. . . . **Ric DiCapua** is having a great time living in New York working for an electronics company. . . . **Ginger Clark** is a geophysics grad student at Yale.

Ted Trueblood reports that he is a civil engineer with the city of Anchorage, Alaska, and is also enrolled in graduate engineering management at the University of Alaska. "I'm still playing hockey but there is a much longer season here. Started on the ice in the first week of November and won't finish until March or April." . . . **Charles Sollitt** writes, "I am presently employed by the Department of Civil Engineering at Oregon State. I am teaching and supervising research in the Ocean Engineering Program. Current research activities include environmental effects of dredging, estuarine hydraulics, and breakwater stability studies."

Random notes: **Robert Hart** reports that he is "happily married and attending graduate school at Caltech's Seismological Lab." . . . **Faruq Ahmad** is at Stanford in the radio science group. . . . **Yong-Yong Tam** is a student at Harvard Medical School. . . . **Dave Krackhardt** graduated in January and will be working for Price-Waterhouse.

Hopefully no mistakes this month but you tell me. That's it until May.—**Dick Fletcher**, Secretary, 135 West St., Braintree, Mass. 02184

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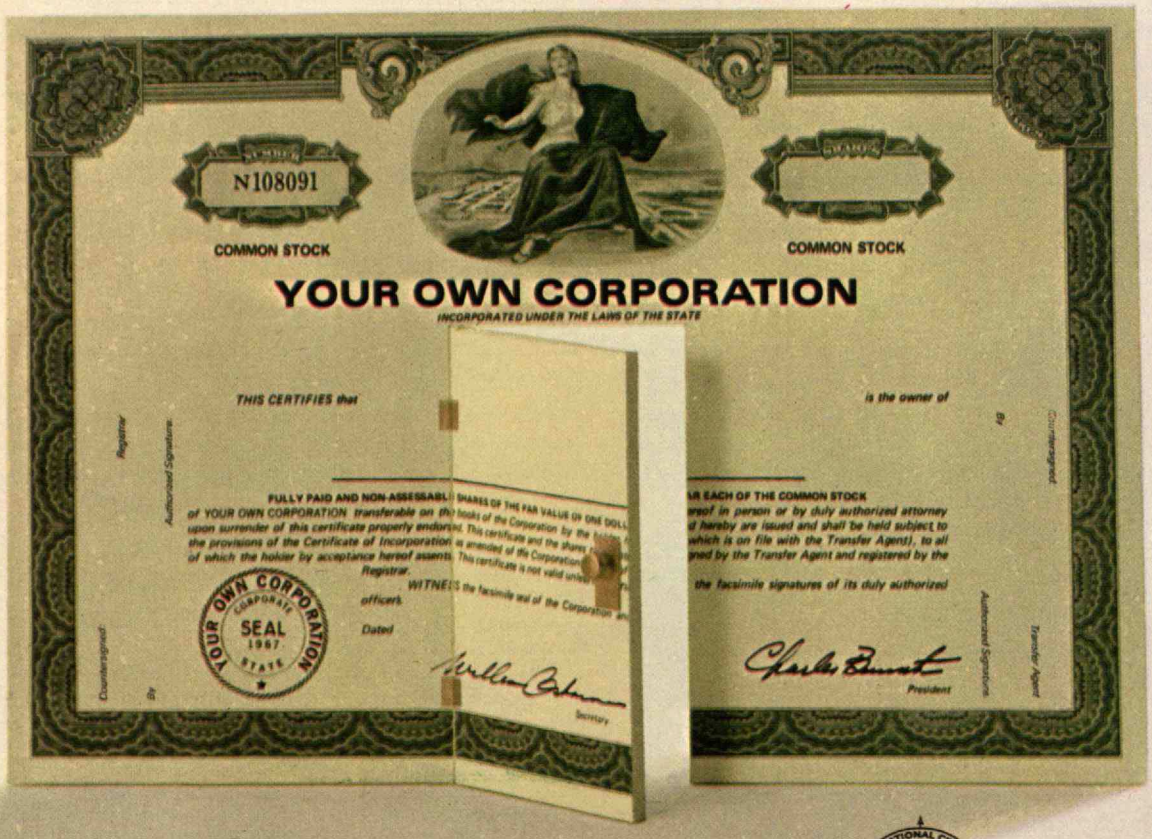

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